



*The 120 kV switchgear at
the new receiving station
at Sundsvall. (F 667)*

ASEA JOURNAL

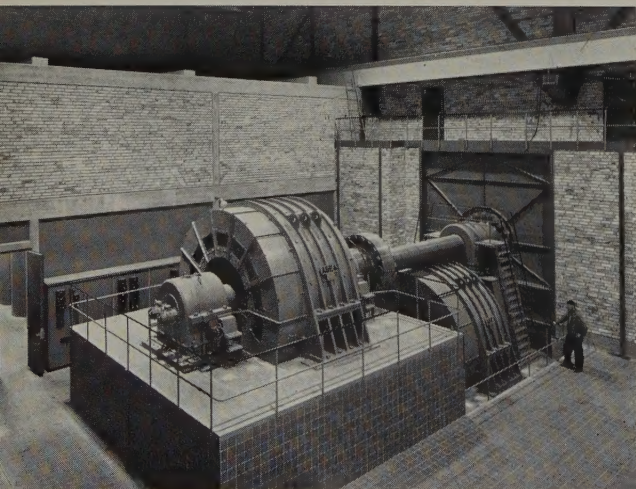
1961

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Complete electrical equipment for rolling mills



(56562)

The new slabbing and heavy-plate mills at the Oxelösund Steel Works, situated south of Stockholm, constitute the most recent additions to its manufacturing facilities. ASEA have supplied the complete electrical equipment for both these mills. Each one is driven by two reversible twin-drive d.c. motors with one motor operating each work roll. The maximum torque for each driving machine is 2×200 tm, corresponding to a maximum output of 25,000 h.p.

The motors are supplied from a mercury-arc converter, which makes for efficient running and speedy regulation. The converter equipment is the most comprehensive yet delivered in Sweden for service with rolling mills.

After delivery and commissioning had been carried out according to schedule, the motors proved to be extremely reliable in service, resulting in a considerable improvement in production.

ASEA

THE NEW RECEIVING STATION AT SUNDSVALL

Lennart Dahl, Sundsvall Electricity Authority, Sundsvall

U.D.C. 621.311.4:621.316.1
Asea Reg. 722

The new subterranean receiving station of the Sundsvall Electricity Authority is described. Its design, ventilation, 120 kV switchgear, main transformers, 10 kV switchgear, control equipment, local power, and fire protection are all dealt with.

The Sundsvall Town Electricity Authority takes its power from the Granlo transformer station of Hammarforsens Kraft AB. A 20 kV double line feeds the M2 receiving station at Nacksta and the M1 receiving station at the Electricity Authority offices in the middle of the town. A 120 kV line feeds the new receiving station known as M3 in the southern part of the town. The general lay-out of this station is shown in Fig. 1.

The distribution of power from the M1 station is to be transferred in stages to the M3 station, and, at the same time, the voltage is to be increased from 5.5 kV to 11 kV. The central control room at the M1 station will however be retained.

The entire electrical equipment for the receiving station was supplied by Asea.

Asea have recently supplied equipment for receiving stations to a large number of Swedish towns. The receiving station at Sundsvall which is described in this article is an example of an installation of this kind.

THE GENERAL DESIGN OF THE STATION

The entire station has been blasted out of the rock with the exception of the 120 kV switchgear. This is of outdoor design (see the cover illustration) and has been built up on the waste rock taken out from the station site and which forms a platform in front of the cavity in the rock. From here, an air and cable intake tunnel runs to the transformers, the 10 kV switchgear and the control room. The entrance tunnel, which is some distance away, has a cross-section which permits the transport through it of the main transformers. The two tunnels are provided with regulation civil defence devices.

The cavity in the rock is divided up into two parallel, longitudinal galleries, which are joined by means of cross-tunnels, one at each end. The entrance tunnel terminates at the end of the one gallery, which has room for three transformers, neutral-point equipment, CO₂ batteries and a spare room. From the transverse tunnel next to the entrance tunnel, there is direct access to the cable cellar and the two switchgear floors. The other transverse tunnel contains the control room, stores, the station distribution board, battery room, rooms for the

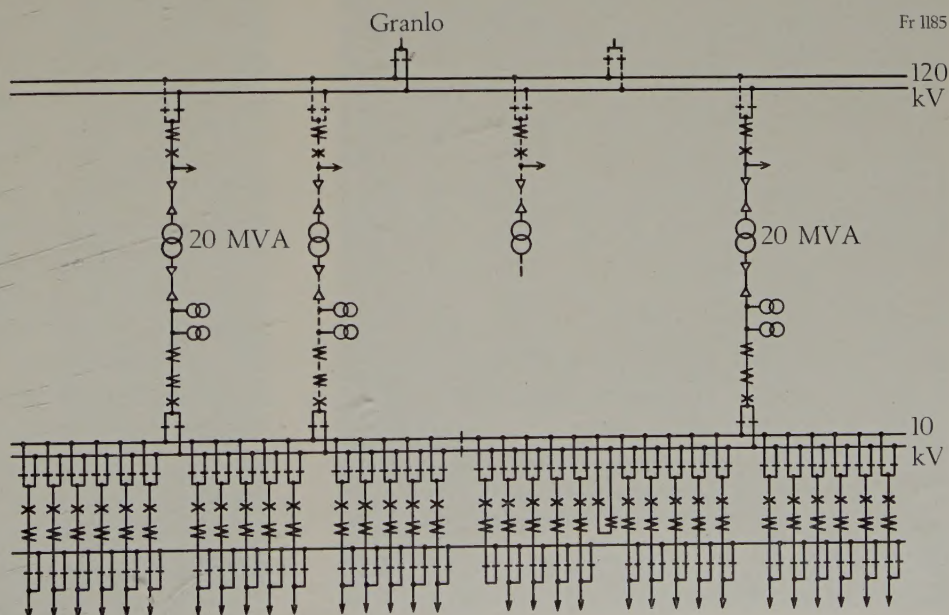


Fig. 1. Diagram showing the arrangement of the new M3 receiving station at Sundsvall. The 120 kV switchgear has been built for one incoming line and two main transformers, but room has been left for another incoming line and two more main transformers (dotted lines in the diagram).

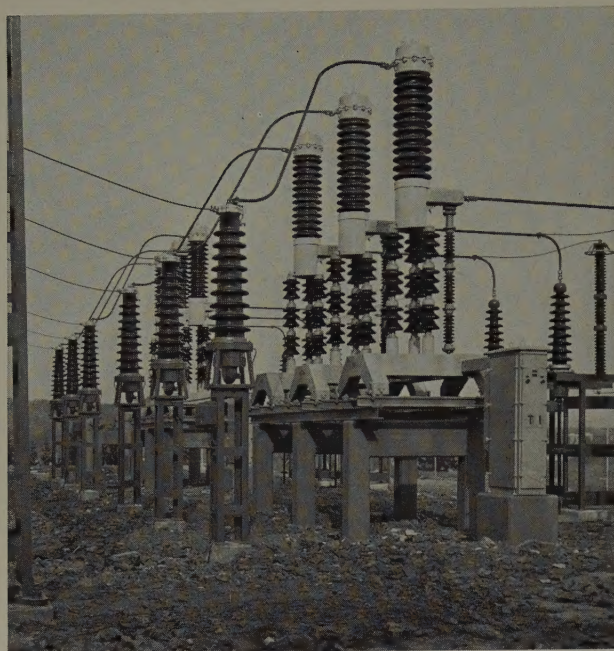


Fig. 2. The 120 kV switchgear with current-transformers, circuit-breakers with operating gear, 120 kV cable boxes and lightning arresters. (54011)

Fig. 3. Part of a transformer showing the expansion couplings in the oil pipes and one of the cable boxes. (54014)

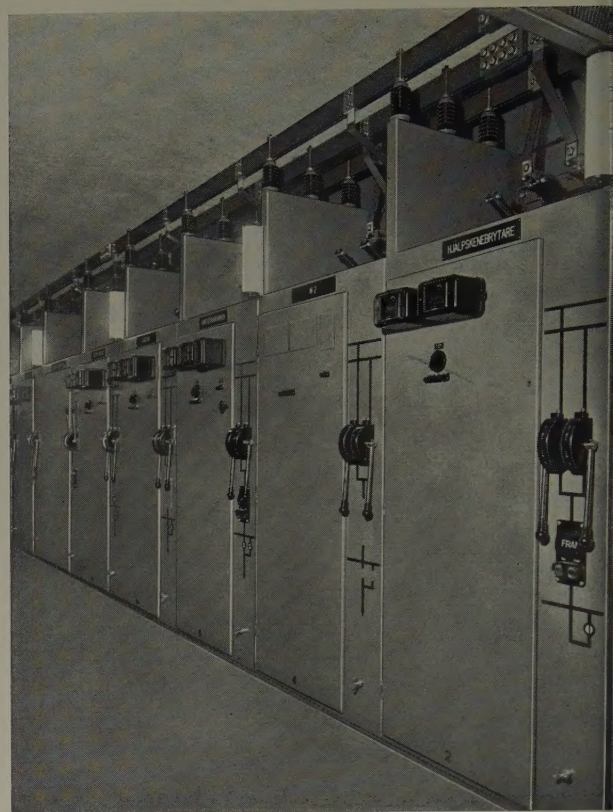
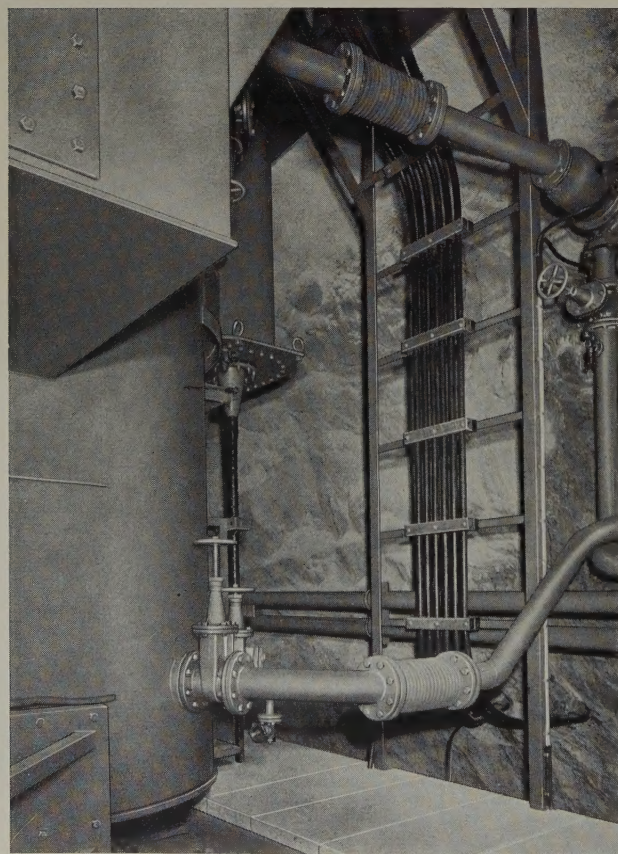


Fig. 4. The front of the 10 kV switchgear on the circuit-breaker second floor. (54017)

personnel and the fan room. The fresh air is taken to the fan room through an air-inlet tunnel. The heat losses of the transformers are used to heat up the station. Normally, in compartments in the rocks, the air becomes saturated with moisture. Where this fact has no significance, the bare rock forms the only wall surface. Elsewhere, walls of brick or concrete screen off the rock surface. The ceilings consist of concrete sprayed on a metal mesh away from the rock. In the space between the walls and the rock surface, hot air is blown in with the aid of fans so that the air is kept dry as far as possible.

VENTILATION

The transformer is cooled in separately mounted coolers by forced air. From these coolers the heated air is distributed from the fan room through special ventilation sets to the upper and lower switchgear floors. The excess air is exhausted through the entrance tunnel. If the load on the transformers is so low that the heat generated is inadequate for heating the entire cavity in the rock, additional heat is provided by means of electric batteries installed in the ventilation sets. The hot air is blown into the various parts of the premises through grilles except in the control room where it comes in through the perforated ceiling. The air goes out through valves

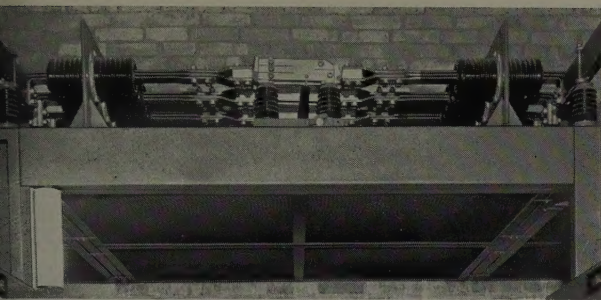


Fig. 5. The sectioning isolators in the busbars and the screens with bushings which prevent the progress of arcs along the bars. (54024)

in the outer walls and passes through the space between these and the rock face, whereupon it is exhausted into the entrance tunnel by means of a centrifugal fan. There are separate air evacuation arrangements for the battery room and the lavatories.

THE 120 kV SWITCHGEAR

The 120 kV switchgear (see the cover illustration) is designed for a short-circuit power of 2,500 MVA and has double busbars consisting of copper wire with a cross-sectional area of 150 mm² (0.23 sq. in.). It has been built with one incoming line and two main transformers, but with room for another line and two more main

Fig. 6. The cable cubicles in the 10 kV switchgear lowest floor. The shelves for the control cables are mounted on the cubicles. (54025)

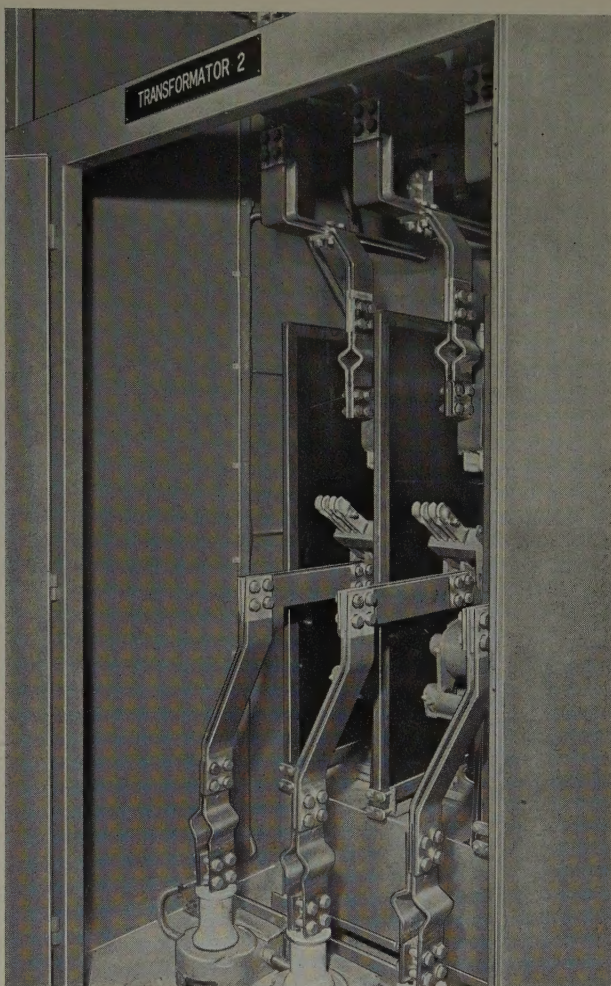


Fig. 7. Circuit-breaker cubicle for 10 kV, 1,600 A, seen from the rear. (54019)

transformers (see Fig. 1). Since it is important that the switchgear should take up as little space as possible, a special switchgear design has been used which, amongst other things, implies the setting up of all the busbar isolators in rows. Thus, no lateral displacement of the cubicle is required, but two lines or transformers can be connected up opposite each other to the two busbars.

The 120 kV system is directly earthed at Granlo and, in the event of a fully developed earth fault, the current may reach about 5,000 A. Therefore, for protective earthing, a grid consisting of copper wire with a cross-sectional area of 50 and 70 mm² (0.08 and 0.11 sq. in.) has been put down.

The circuit-breakers are of oil-minimum type with remotely controlled motor operating gear. They have a breaking capacity of 2,500 MVA at 120 kV. In addition to the circuit-breakers, Fig. 2 also shows the current-transformers, which are of oil-minimum type, as well as lightning arresters and the cable end-boxes for the oil-filled single-phase transformer cables which have a cross-sectional area of 95 mm² (0.15 sq. in.).

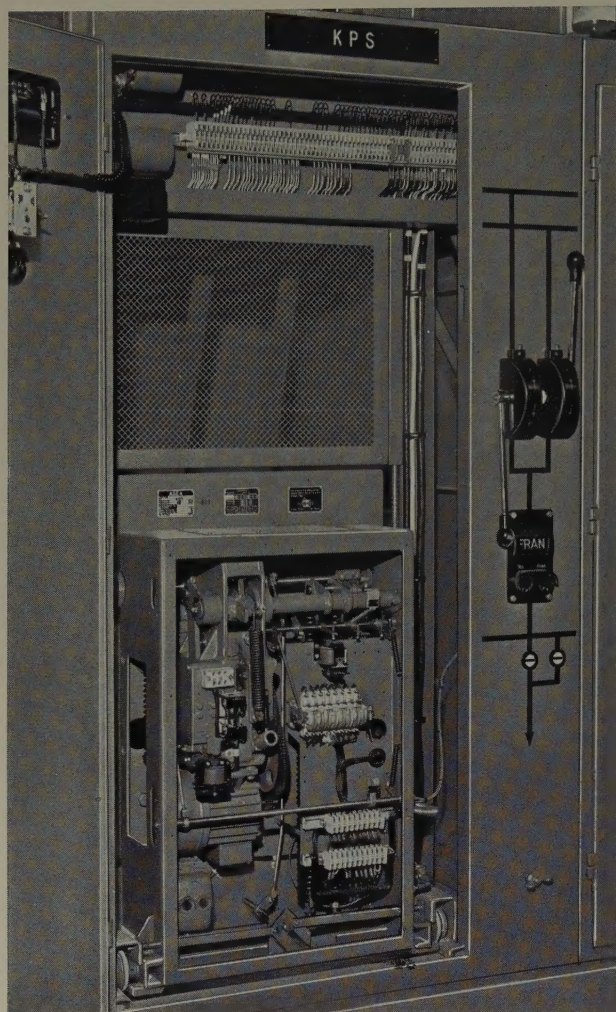


Fig. 8. Circuit-breaker cubicle for 10 kV, 600 A, with the circuit-breaker truck in the inserted position. (54020)

MAIN TRANSFORMERS

Each transformer has a rating of 20 MVA, no-load ratio $132 \pm 7 \times 1.9\% / 11$ kV and is connected up in Y-0/Y-0. For voltage regulation purposes, it is provided with extra tapplings, at the neutral point of the high-voltage winding, connected to a motor-operated, high-speed on-load tap changer. The neutral point is also provided with a lightning arrester.

The cooling is arranged as mentioned under ventilation. The separate coolers are placed in the fan room and the oil from the transformer is circulated with the aid of oil pumps built into the pipes. These pumps have no stuffing boxes.

The three 120 kV single-phase cables are led directly into the transformer through cable boxes mounted on one of the long sides of the transformer. The link between the transformer bushing and the cable is so made that it can be separated for voltage tests on the cable without having to dismantle, or interfere with, any of the insulating components.

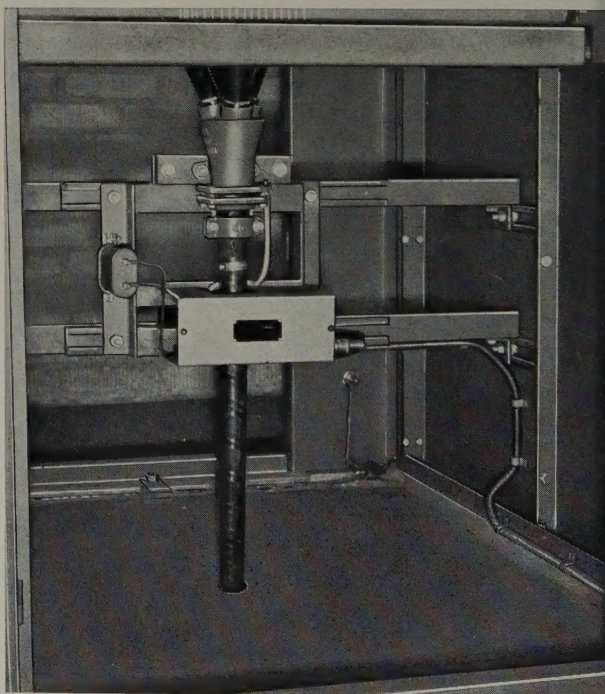
The secondary side of the transformer is connected to the 10 kV switchgear by means of two parallel cables per phase, each having a cross-sectional area of 300 mm² (0.47 sq. in.). In order to simplify the lay-out of the cables, they run in holes drilled through the rock.

Fig. 3 shows part of a transformer in its compartment in the rock. Starting from the left, part of the diverter switch box of the on-load tap changer, and expansion couplings in the oil pipes can be seen. In the background, a glimpse can be seen of the cable boxes for the 120 kV cables and, on the wall, the 10 kV cables.

THE 10 kV SWITCHGEAR

The 10 kV switchgear (Fig. 4) is designed for a short-circuit power of 400 MVA and has double busbars and an auxiliary busbar. It is made of prefabricated elements of bent sheet steel which are assembled at the site. The main busbars, which consist of two parallel 100 × 7 mm (3.94 × 0.47 in.) aluminium busbars per phase, can be sectioned with the aid of isolators (Fig. 5) and have been provided with bushings at suitable points to limit the progress of arcs along the bars. The auxiliary busbar (Fig. 6) in the lowest floor can be connected to the two main busbars via circuit-breakers and four connected isolators. Any one of the circuit-breakers for the outgoing cables can be taken out of service and the appropriate cable then connected across the isolators to the auxiliary busbar and via the cubicle for the auxiliary busbar circuit-breaker to a main busbar. The cable is provided with normal protection all the time since the

Fig. 9. Outgoing cable in the 10 kV switchgear with a cable current-transformer for earth-fault indication. (54027)



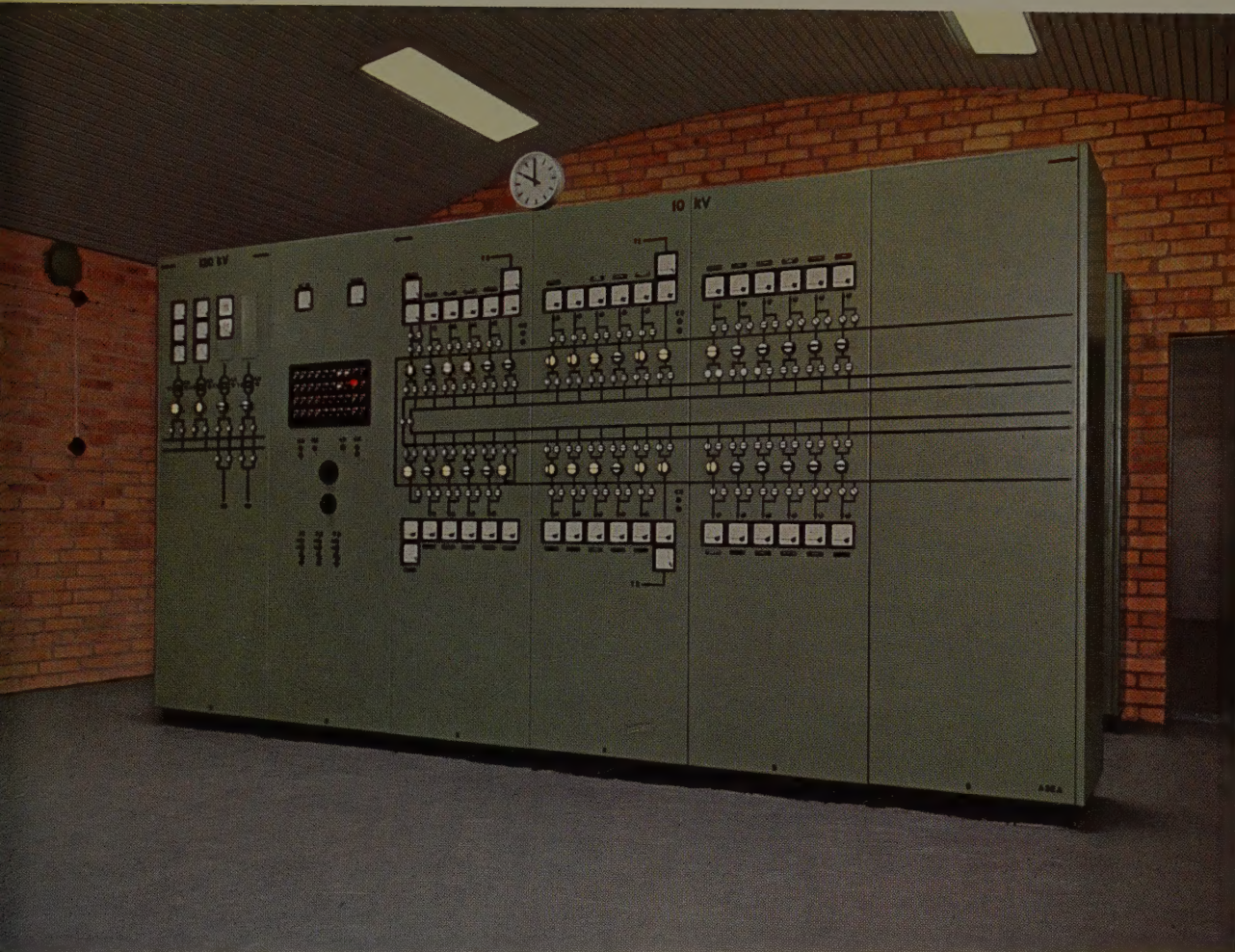


Fig. 10. The control panel in the M3 receiving station. All the circuit-breakers in the station can be remotely controlled from this point, the position of the isolators being indicated at the same time. (F 660)

auxiliary busbar cubicle is provided with the same relay protection as the cubicles for the outgoing cables. In this way, all the circuit-breakers can be inspected and tested while dead without interrupting service.

The circuit-breakers are of oil-minimum type and are provided with remotely-controlled motor operating gear. The rating of the switching circuit-breakers and the transformer circuit-breakers is 1,600 A, and of the others 600 A. The circuit-breakers and operating gear are mounted on a common truck and can be withdrawn from the cubicle after the connections have been removed (Figs. 7 and 8).

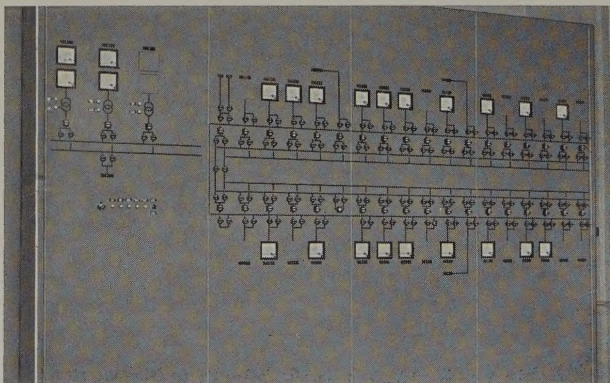
The isolators are of three-pole design and are manually operated. For the transformer cubicles and the switching circuit-breaker, as well as for sectioning the busbars, they are designed for 2,000 A, while the other ones have a rated current of 400 A.

The current-transformers are of bushing type and have dry-type insulation, while the voltage-transformers are of oil-minimum type.

CONTROL EQUIPMENT

In addition to gas-operated relays, the transformers are provided with differential protection and standby short-circuit protection, while the outgoing cables are provided with over-current protection in two phases. Earth faults are indicated selectively by means of earth-current relays connected to the cable current-transformers (Fig. 9). For each main transformer there is a resistor

Fig. 11. Part of the control panel for the M3 station in the central control room in the M1 station, from which the circuit-breakers can be remotely controlled and to which certain indications and measuring values are transmitted. (54138)



which limits the earth-fault current to 15 A. Relay protection for the outgoing cables is located on the switchgear cubicles, while the other protection and the automatic voltage regulation for the transformers is situated on a separate relay panel.

The control panel, the relay panel and the metering panel are set up in a separate control room. Since the station is to be unstaffed, this is relatively small. Thus, the control panel, for example, has been so designed that the control devices for twelve 10 kV switchgear cubicles have been arranged in a panel width of 700 mm (27.6 in.) without reducing the insulation level which is at least 2 kV.

All the circuit-breakers in the station can be remotely controlled from the control panel (Fig. 10) and the position of the isolators can be indicated. In addition, the circuit-breakers can be remotely controlled from a control panel (Fig. 11) in the central control room in the M1 station. Certain other indications and measuring values are also transferred to this latter board. In the case of a fault, the responsible personnel are warned automatically.

LOCAL POWER

The power required by the station itself is provided by two local transformers, of which one is in reserve. They are set up in bays next to the room containing the low-voltage distribution board.

There is a lead-acid accumulator battery with a capacity of 63 ampere-hours with a 10-hour discharge and a voltage of 2×55 V for supplying the pilot circuits and the emergency lighting system. The battery is kept charged

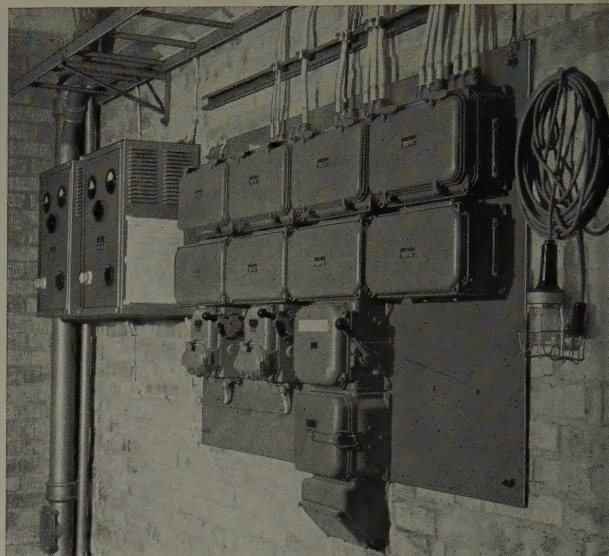


Fig. 12. Enclosed d.c. distribution board for 110 V and the avostat rectifiers for keeping the battery charged. (5403.)

by means of avostat rectifiers which are located in an adjacent room. This room also contains the d.c. distribution board which is fed from the battery via bushings (Fig. 12).

FIRE PROTECTION

The main transformer bays have been provided with nozzles for CO₂ extinguishing. This system is automatically set into action by means of thermal contact. Otherwise, powder-type and CO₂-extinguishers of portable type are placed at strategic points in the installation. The entire installation is connected to the alarm board at the fire station by means of a fire-alarm.

A 55 MVA, 94 r/m GENERATOR AT STENSELE

Tage Strömberg, Machine Design Department, Västerås

Asea Reg. 44

In 1960, Asea supplied to Stensele Power-station a 55 MVA, 94 r/m generator which is interesting because of its large dimensions and because of the locating of the thrust bearing on the turbine cover. The arrangement can be seen from the illustration. The thrust bearing rests on a frame which is carried by the turbine cover. The guide bearing of the turbine is beneath the thrust bearing and, above it, beneath the rotor, is the guide bearing of the generator. Thus, the thrust bearing is not combined with any guide bearing, and there is, in fact, no such bearing on the upper side of the rotor. The

shaft is divided between the thrust bearing and the turbine wheel. A shaft extension is fixed in the normal way above the generator rotor in order to carry the exciter and slip rings and the combinator.

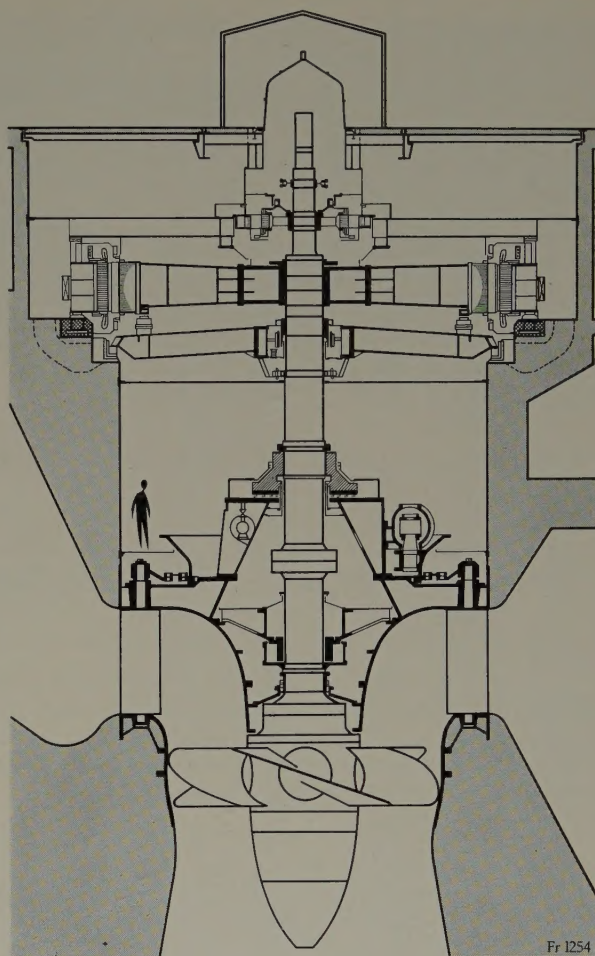
The order was divided up between the turbine manufacturer, Finnshyttans Bruk, and Asea, in such a way that Finnshyttans Bruk supplied the entire shaft and the bracket for the generator guide bearings, while Asea supplied the thrust bearings with frame, the guide bearings and the braking equipment.

The locating of the thrust bearing on the turbine cover was justified by the fact that the turbine cover, for other reasons, had to be of such a robust design that, without any particularly great extra cost, it could be made to carry the entire load of 1,130 tons on the bearing. An advantage of this is that the large and heavy thrust-bearing bracket is eliminated and replaced by the considerably lighter bracket for the guide bearing of the generator. Further, space can be gained vertically, which is an advantage if the space thus saved can be utilised in some other way. Such is not the case at Stensele, where the locating of the generator was determined by other factors, and consequently no attempt was made to design a rotor spider with slanting arms. On the other hand, this design will be used in a number of stations to be built later.

In this connection, it may be of interest to look back. There is nothing novel about designing a set with only two guide bearings. Asea used this design on several large generators as early as the 1930's. In these cases, the combined thrust and guide bearing was located beneath the rotor, and the turbine guide bearing was in its normal place, but no upper generator guide bearing was employed. As far as we can ascertain, the first use to be made of a thrust bearing on the turbine cover was in 1939 in several small power-stations built by Rhein-Main-Donau AG¹. The main consideration in these cases was to reduce costs by cutting down the height of the building. Since then, this design has been adopted with great advantage for very large installations on the Continent. In general terms it may be said that one requirement must be fulfilled, that is, that there should be adequate room on the turbine cover for the thrust bearing with its oil tanks, cooler, piping, etc. It is therefore more natural to use this design on large Kaplan turbines designed for a water flow of about 200 m³/s and over, while it is less natural to adopt it for more rapid machines, even though their power is relatively great.

Asea have made very careful calculations on the shaft system with reference to its stability in service, special attention being devoted to the magnetic forces. It is not

¹Die technische Entwicklung der Wasserkraftanlagen bei der Rhein-Main-Donau AG. Sonderdruck aus der Festschrift zur Eröffnung der kanaliserten Mainstrecke Würzburg-Ochsenfurt 18. Juni 1954. Selbstverlag der Rhein-Main-Donau AG. München 1954.



Fr 1254

sufficient merely to take into account the flexibility of the shaft, but the flexibility of the guide bearings and the bracket for the guide bearings of the generator must also be borne in mind. It is a considerable simplification that the resonance speed and the bending of the shaft can be calculated with the aid of a computer, and it then also becomes very simple to study the effect of changes in the shaft dimensions.

The Stensele generator was taken into service at the end of September, 1960. Special attention has been paid to the way in which the top of the generator moved when the load was switched off, which is of interest with reference to the combinator (a regulating device) and the play in it. Disconnection of the load and emergency stopping were carried out without vibration.

A TRANSFORMER BANK WITH THE RECORD-BREAKING RATING OF 1,000 MVA

Petter Hessen, Transformer Design Department, Ludvika

U.D.C. 621.314.212.027
Asea Reg. 471

Brief description of a 1,000 MVA three-phase transformer bank for 400 kV supplied to the Swedish State Power Board in 1960.

Fig. 1. The core is built of cold-rolled grain-oriented steel, and the use of five limbs has permitted the tank height to be kept within the limits specified for transport. The completed core, weighing 110 tons, is shown ready to be lifted by means of a lifting beam suspended between two overhead cranes. (54228)

The 1950's have been the decade of the 400 kV transformers in Sweden. No less than sixty 400 kV transformers with a total rating of 9,000,000 kVA had been supplied by Asea within the country since the initiation of the Swedish 400 kV system in 1952 and up to the end of 1959.

One of the most remarkable of these deliveries is a transformer bank with a rating of 1,000 MVA, com-



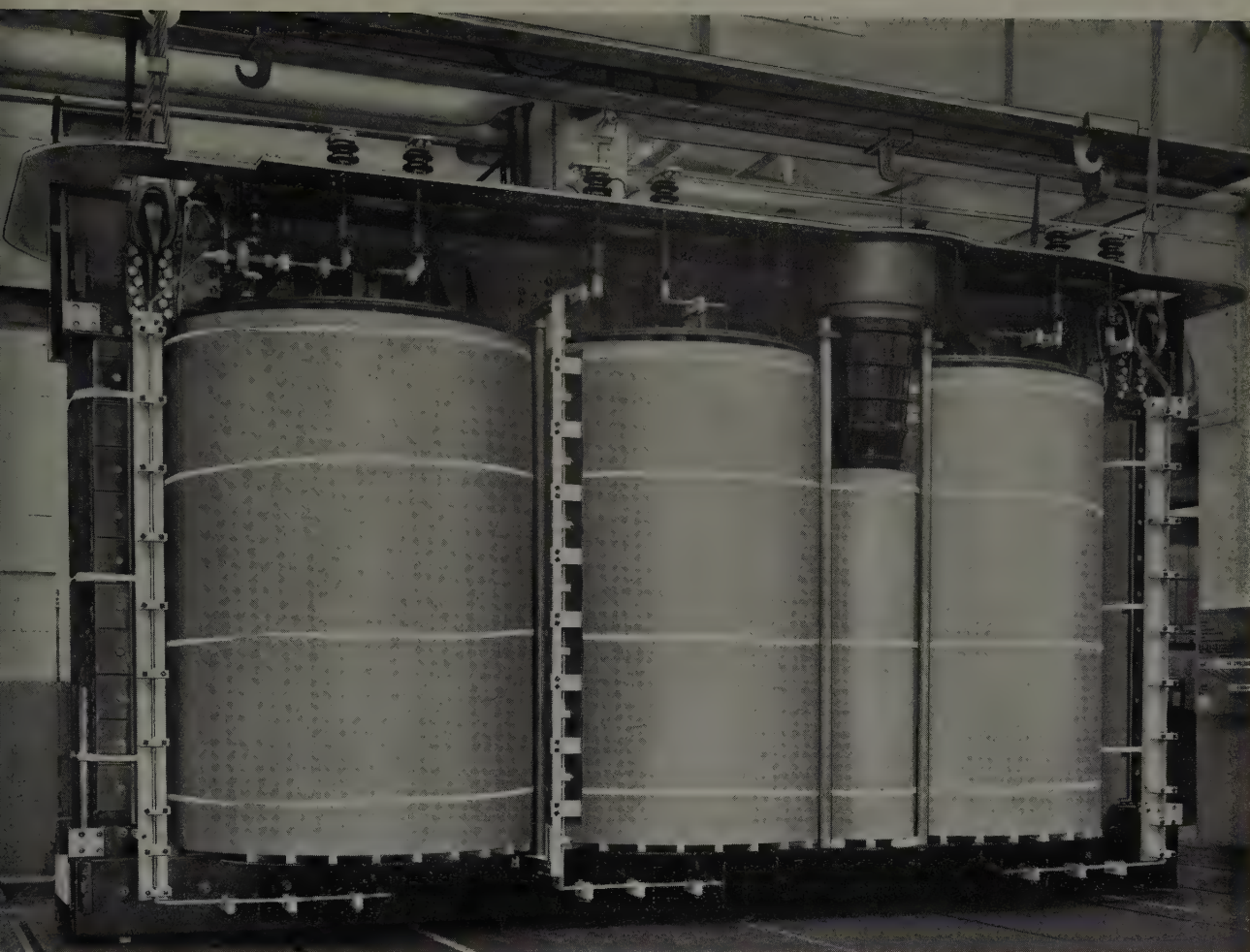


Fig. 2. The windings are covered with insulating cylinders. The porcelain for the lower part of the 400 kV bushing is mounted in the cover and the lead from the windings is brought into the bushing through an oil-tight fitting. (54232)

prising three single-phase units and one spare unit. As far as is known, this transformer bank is the largest of its kind in the world at present with regard to its rating.

The data for the three-phase bank are as follows:

Rating	1,000/1,000/333 MVA
Rated voltage	400/217/20 kV
Connection	Auto-star/Delta
Frequency	50 c/s
Impedance voltages	
400 to 217 kV, u_{sc}	= 8 % on 1,000 MVA base
400 to 20 kV, u_{sc}	= 10.2 % on 333 MVA base
217 to 20 kV, u_{sc}	= 7.3 % on 333 MVA base

The basic insulation levels are:

400 kV winding	1,500–900 kV, graded insulation
217 kV winding	900–375 kV, graded insulation
20 kV winding	125 kV

Each single-phase unit has the following data:

Weight including oil	259 tons
Transport weight	187 tons
Over-all dimensions	
Length	11.5 m (37.7 ft)
Width	5.0 m (16.4 ft)
Height	9.1 m (29.9 ft)

The transformers are designed for continuous operation at 110 per cent rated voltage, corresponding to a 10 per cent higher rating at this voltage.

THE DESIGN OF THE TRANSFORMERS

Core

To permit transport within the railway loading gauge, a five-limbed core design with windings on three limbs was adopted. This core type has been used previously by Asea for 400 kV transformers, but the detailed design of the core has changed considerably since Asea supplied the first transformers to the Harsprånget Power-station and the Swedish 400 kV system in 1951–1952.

Continuous development work with the object of achieving optimum core design and maximum service reliability has led to refinements in the design, adapted to the use of grain-oriented steel.



Windings

Both the 400 kV and the 217 kV windings are of disc type with all three limbs of each winding connected in parallel. The 20 kV windings are also identical on each limb.

The 400 kV line entry is half-way up on the limb. The 400 kV winding on each limb has two parallel-connected sections, thus permitting the same insulation level at the yokes as at the line end of the 217 kV winding.

The entrance coils are provided with the same type of electrostatic shielding ring as previously used for all transformers of this voltage manufactured by Asea. In spite of the simplicity in design, this shielding arrangement gives a good voltage distribution in the windings both between adjacent coils and to earth.

The calculation of this voltage distribution for $1/50 \mu s$ full and chopped waves no longer presents any major difficulties. The internal insulation between adjacent turns and coils in the windings is designed to match the actual voltage distribution with approximately the same factor of safety throughout the whole winding.

The extremely good experience obtained during many years of service and from the impulse testing of such transformers has established the quality of this type of winding and shielding arrangement.

Impulse tests and power-frequency tests have been successfully carried out on each unit.

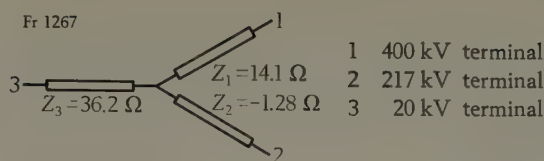
Short-circuit strength

The transformers are designed to withstand safely the largest forces encountered under short-circuit conditions. Each winding is compressed by means of a series of drying, pressing and impregnating processes to produce and maintain the correct height of the winding when the maximum pressure liable to occur under short-circuit conditions is applied. These pre-shrinking operations are carefully controlled, and experience has shown that windings checked during reconditioning after many years of service still maintain the same pressure as new when they are compressed to the same height.

The available short-circuit powers in the connected systems are governing factors in the design of transformers of this size. To illustrate this, a simplified example is given here, in which the current fed in from the 20 kV side is neglected.

The impedance of 8 per cent on a 1,000 MVA base signifies a short-circuit current of 12.5 times the rated current with infinite short-circuit power in the system.

Fig. 3. 1,000 MVA three-phase transformer bank. (56105)



Z_1, Z_2, Z_3 Impedances of the transformer bank referred to 400 kV

Fig. 4. Equivalent circuit for the short-circuit impedances.

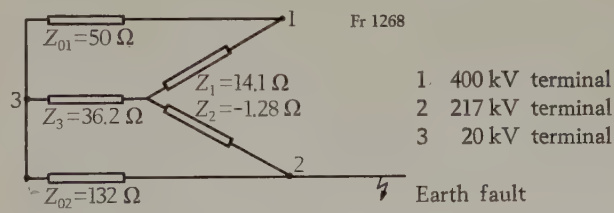
However, if the available short-circuit power is limited to, for example, 15,000 MVA (equivalent to a system impedance of 6.7 per cent on a 1,000 MVA base), the short-circuit current is reduced to 6.8 times the rated current. The forces in the windings are thus reduced to about 30 per cent of the previous value. This indicates quite clearly the important difference for these large transformers between infinite short-circuit power in the system and, for example, 15,000 MVA, which for smaller units may be considered as infinite without significantly influencing the transformer design.

The calculation of the short-circuit and earth-fault currents in the windings is, of course, more complex than the above example would appear to indicate. However, since all three parallel-connected limbs have similar winding arrangements, a symmetrical distribution of the fault currents in the three limbs can be assumed. The transformers can therefore be treated as three-winding transformers.

The equivalent circuit for one phase based on measured values of the impedances is given in Fig. 4.

The significance of the system earthing conditions is indicated quite clearly by the equivalent circuit of the zero-sequence impedances for an earth fault on the 217 kV side shown in Fig. 5.

When calculating the earth-fault currents in the windings, the method of symmetrical components may be used. The equivalent diagrams for the positive and negative components then consist of Fig. 4 supplemented by the addition of the system impedances.



Z_1, Z_2, Z_3 Impedances of the transformer bank referred to 400 kV

Z_{01}, Z_{02} Zero-sequence impedances of the systems

Fig. 5. Equivalent circuit for the zero-sequence impedances.

A simple calculation shows that about 85 per cent of the total earth-fault current has to pass the transformer windings.

Bushings

The bushings, all produced by Asea, are among the largest ever manufactured for these high voltages.

The 400 kV, the 217 kV as well as the neutral bushings are of the draw-lead type. This allows mounting of the bushings without lowering the oil level in the transformer tank.

The ratings of the high, and medium, voltage bushings are as follows:

400 kV:	BIL	1,550 kV
	Max. operating voltage	420 kV
	Rated current	1,550 A

217 kV:	BIL	1,050 kV
	Max. operating voltage	245 kV
	Rated current	3,000 A

Cooling equipment

Cooling is provided by ten forced-oil, air-blast heat exchanger units for each single-phase transformer. Eight of these are mounted directly on the transformer and two are set up separately. For each transformer an air flow of approximately 4,100 m³/minute is required. This large air flow makes it essential that adequate consideration be given to the problem of ventilation.

The oil circulation of approximately 6,000 litres per minute for each unit is handled by five pumps. The cooling equipment is thermostatically controlled by the top-oil temperature in such a way that at any loading only the required number of coolers will be in service.

ASEA ACTIVITIES DURING 1960

Characteristic features of the activities of the Asea Group during 1960 were a high rate of orders and increased production. The turnover of the Group amounted to 1,353 Mkr and of the Parent Company to 735 Mkr; both these values are the highest ever achieved. At the end of 1960, the Asea Group employed 30,681 persons in Sweden and about 2,700 elsewhere.

One of the Group companies, Graham Brothers AB, has, by virtue of an agreement with the Parent Company, taken over the entire responsibility for the lift programme of the Group. On 1st January, 1961, the name of the company was changed to Hiss AB Asea-Graham. The Parent Company has taken over the activities of AB Härnöverken (except property administration) and concentrated the manufacture of trucks in a newly formed Asea-Härnö Truck Division in Härnösand.

THE PARENT COMPANY

The turnover of the Parent Company amounted to 735 Mkr (653 Mkr in 1959), which is more than in any previous year. The value of orders received was a record and exceeded the value of deliveries made. The increase in orders received, in deliveries and in the back-log of orders was particularly noticeable in the case of equipment for industrial purposes. Export orders increased more than orders on the domestic market. A feature of

the market was high sales volume combined with keen price competition.

The average number of persons employed by the Parent Company was 18,511 (17,576 the previous year), of whom 8,202 were salaried staff (7,820) and 10,309 were wage-earners (9,756).

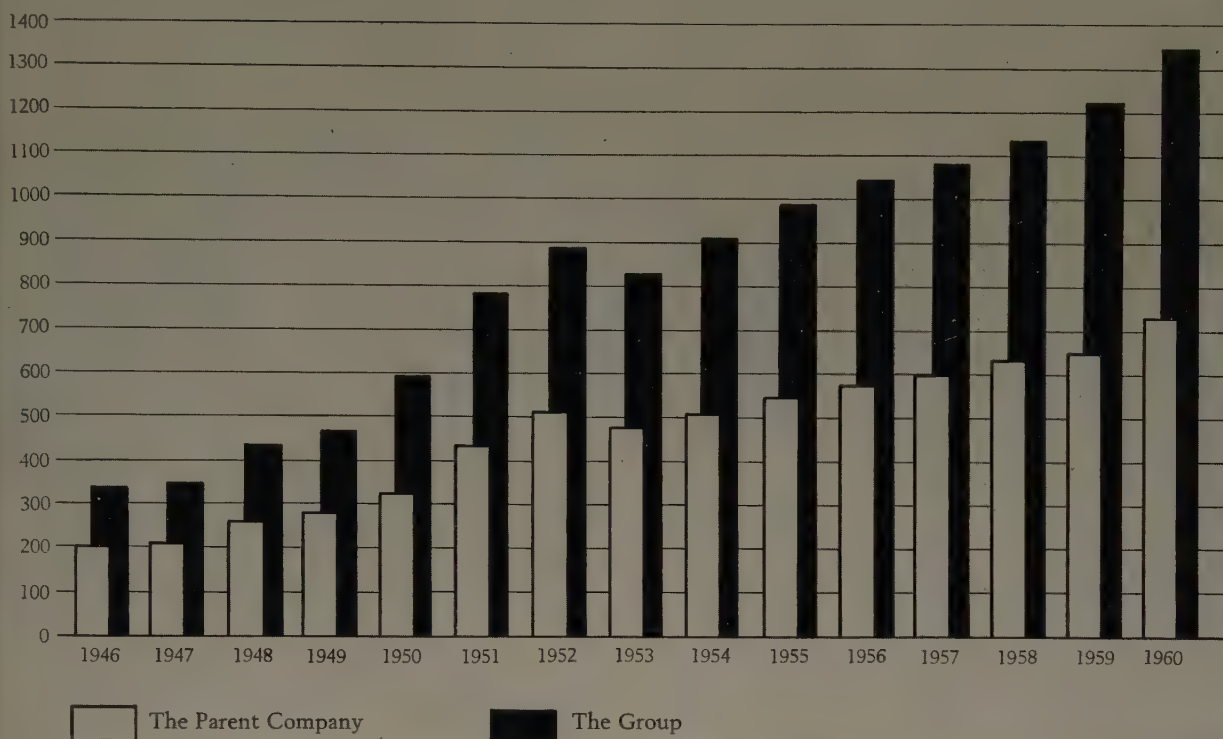
Production and investments

Supplies of raw materials have, in the main, been satisfactory. However, shortages of a few items, and increased delays in the delivery of purchased materials have, to some extent, slowed down the increase in production.

The supply of unskilled labour has been satisfactory, and the number of wage-earners has increased during the year by about 800 persons. However, as previously, there has been some shortage of skilled and specialist labour. In order to cover the more urgent requirements, skilled labour has been recruited from abroad to a limited extent. Further, the Company's own education and training programme has been intensified.

The courses and campaigns introduced in previous years for better care of tools and machines, better quality awareness, better utilisation of materials, etc. have continued. Courses in cutting technique have been arranged for foremen and time-and-motion-study engineers in order to further economical utilisation of machines and tools. Asea has adopted the new international unified thread system.

Mill. Sw. Kr.



Turnover 1946-1960. In order to facilitate comparison between the various years, the turnover of those companies which were previously run on a commission basis has been subtracted from the turnover of the Parent Company. For the same reason, the turnover of the companies previously belonging to the Group, but which have now left it, has been subtracted from the turnover of the Group. (Fr 762)

The new extension to the Head Office has been taken into use in its entirety. A factory extension is now being used for the manufacture of relays. The major part of the building work on the heavy welding and machinery workshops in the Finnslätten area on the northern outskirts of Västerås – the largest concrete industrial building in Sweden – was completed during the year, and work is now going on to finish the interior.

Work has started on a new workshop for punching core sheet at the Örjan factory. The manufacture of components for nuclear power-stations has been arranged in a part of the furnace workshop in the main group of factories at Västerås.

A new chemistry and physics laboratory has been taken into use at Västerås. A laboratory has been built at Vällingby on the outskirts of Stockholm for research in the increasingly important field of semi-conductors.

In Härnösand, the foundry has been closed down and its activities have been transferred to Västerås. The old

foundry premises have been rebuilt in order to make possible an expansion in the manufacture of worm gears and trucks. A new central-heating plant has been taken into use.

In Norrköping, the major part of the building works for a new service workshop with office and stores is complete.

Market conditions

In 1960, orders increased in all branches of activity, and the value of these orders was the highest ever recorded. However, a characteristic feature of the year was a high rate of production combined with reduced sales margins. A number of Asea's foreign competitors still appear to have a surplus of productive capacity. The competition for almost every major item sold both in Sweden and abroad was very keen. As far as competition on the export market is concerned, the often considerably higher rates of Customs duty and a sentimental preference for domestic manufactures have caused Asea some difficulties. Another disturbing tendency as far as export sales are concerned is that more and more major purchases are coupled with demands for longterm credit.

As a result of the reduction in pace in the building of Swedish hydro-electric stations, the demands for heavy power-station equipment remained low on the Swedish



The largest concrete factory building in Sweden: The new Asea factory for large generators at Finnsälätten on the outskirts of Västerås. The building is 210 m (690 ft) long and has a floor area of 27,000 m² (290,000 sq. ft). Occupation of the building will commence after the summer holidays in 1961. (Z 12132)

market. However, on the other hand, the more rapid extension of distribution networks as compared with 1959 led to a considerable increase in orders from electricity generating and distribution authorities for high-voltage switchgear and other distribution equipment.

The high rate of investment activities in Swedish industry was reflected in a still greater increase in orders from practically speaking all branches of industry. In spite of a considerable increase, the production of stocked standard products did not cover the steeply rising demand, and, consequently, this led to a continued reduction in stocks of finished products.

On the export market, the Company's efforts to obtain orders for large generators, transformers and high-voltage switchgear have been successful, and new markets have been captured. A most satisfactory development is that, in keen competition with American and European manufacturers, the first orders from the U.S.A. for large generators and transformers have been secured during the year.

The overseas demand for industrial equipment, which doubled during 1959, continued to rise, and this also applied to the sales of standard products. In all, export orders amounted to 28 per cent (25 per cent the previous year) and export deliveries 27 per cent of the total orders and deliveries of the Parent Company.

Technical developments

A characteristic feature of the work of development and design has been the employment of measures to achieve

more effective utilisation of all materials, from the mechanical, thermal and electrical points of view. A thorough-going standardisation of materials, design elements and components is continuing.

New materials, with improved properties, are continually being introduced both into new designs and into redesigned products. There are examples of equipment in which the new designs do not contain any of the materials which were used in the previous designs.

An entirely newly designed series of transformers for use in rural networks is in full production. In conjunction with this, inhibited transformer oil has been introduced throughout which means that the life of the transformer is prolonged.

A lightning arrester with magnetic blow-out has been developed for high-voltage networks; it provides more effective protection against lightning damage than the types of lightning arrester previously used. Contraction type, oil-minimum circuit-breakers have been developed and improved in the High-power Laboratory at Ludvik until they now have higher breaking capacity than was previously thought possible, for example 3,500 MV at a service voltage of 145 kV.

The new contactor series has been supplemented with the sizes 250 and 400 A as well as corresponding motor starters.

Prototypes have been made of a new series of time-lag relays and of a new auxiliary relay variant.

High-power fuses within the entire voltage range have been radically redesigned.

For, amongst other uses, loop regulation in rod and strip mills, a new photo-electric position indicator with appropriate optical devices has been designed.

New geared motors, including a series of bevel-helic geared motors, have been designed and put on the market.



Left: At the Asea Quintus Laboratory in Stockholm a high-pressure press has been developed which, in spite of its small dimensions, can exert a pressure of 100,000 atm. It is used for calibrating pressductors and for manufacturing artificial diamonds. Right: A number of diamonds partially freed from the metal in which they were formed when it was in the molten state. Magnification 20 ×. The development of commercial production methods is continuing.
(Z 12028, 56810)

Other new products on the market are travelling deck cranes running on tracks and mine hoists with friction pulleys of welded shell design and hydraulic disc-brakes.

Orders and deliveries

The Power-plant Department has obtained an order for a 60 MVA hydro-electric generator from the Swedish State Power Board, and for two generators, each rated at 19 MVA, from Stockholms Superfosfat Fabriks AB.

Orders have been received from the U.S.A. for two generators, each rated at 40 MVA, and for one 62.5 MVA and two 58 MVA generators for customers in Norway. Two synchronous condensers, each rated at 75 MVA have been sold to customers in Australia and two, each rated at 60 MVA, to customers in New Zealand.

Turbin AB de Laval Ljungström have ordered a generator for a 50 MVA gas turbine for Hammarforsens Kraft AB, and several large steam-turbine-driven generators for Australia, Italy and Finland.

For the final stage of electrification of the Oslo-Bergen line, the Norwegian State Railways have ordered seven 5,800 kVA mobile converters and equipment for three



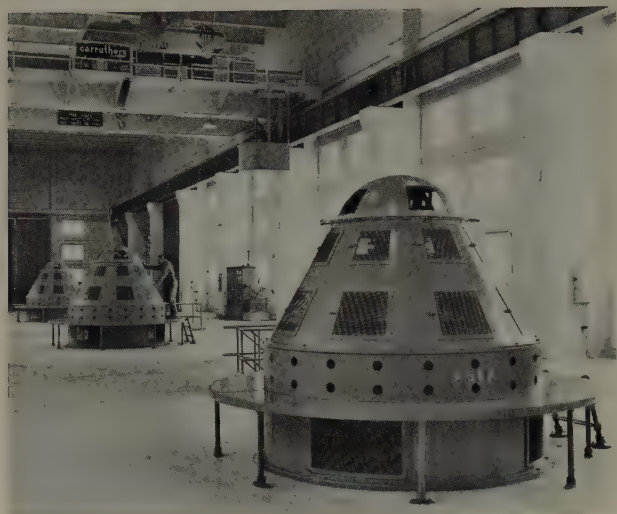
converter stations. The appropriate transformers are being manufactured by an Asea Group company, A/S Per Kure, Oslo.

The Swedish State Power Board has, amongst other things, ordered a 350 MVA transformer which is auto-connected between 400 kV and 140 kV and which has the record transport weight of 225 tons, as well as a shunt reactor rated at 150 MVA at 220 kV. Overseas orders include twelve transformers with a total rating of 840 MVA for the Corps of Army Engineers in the U.S.A., and large units for Thailand and South Africa. Sales of high-voltage circuit-breakers have been brisk. Thus, the Swedish State Power Board has ordered a large number of circuit-breakers within the voltage range 120 to 400 kV, and Krångede AB has ordered 13 air-blast circuit-breakers, each rated at 245 kV. Orders have been received for a considerable number of circuit-breakers rated between 132 and 420 kV for Australia, Canada, India and Eastern Germany.

The demand for instrument-transformers, particularly for high voltages, has further increased.

The Swedish State Power Board has taken into service a three-phase transformer bank with a rating of 1,000 MVA at 400 kV, and, as far as is known, this is the largest tranformer bank in the world (see pp. 102-106).

In collaboration with AB Karlstads Mekaniska Werkstad, Asea has designed and supplied the first bulb set in Sweden, rated at 4,200 kVA, to Yngerefsfors Kraft AB. The remote control of power-stations has been adopted more and more in Sweden and comprises, at present, an



A view of the Atiamuri power-station in New Zealand, which has three Asea generators, each rated at 23 MVA. A fourth generator is under construction. (56708)

installed machine output of over 1,000 MVA. The Swedish State Power Board has ordered equipment for the remote control of Porsi, Laxede and Messaure power-stations on the Lule River. A control station from which five power-stations in the Ätran River with, in all, twelve generator sets, can be operated and controlled, has been taken into use by Yngeredsfors Kraft AB.

The Industrial-plant Department has received important orders for electrical equipment for rolling mills. Most of these are for large installations in Sweden, Belgium and the U.S.A. and are for the steel and non-ferrous-metal industries. In rolling mills, pressductors have been installed to measure roll pressure and strip tension, which latter is a new sphere of use for the pressductor. Rolling-mill pressductors have been sold to customers in Sweden, Britain, France, Germany, and, above all, the U.S.A.

Large arc furnaces have been ordered by Swedish customers. Asea has received its first Australian order for a large arc furnace. Induction stirrers for arc furnaces have been sold in Sweden, Japan, Italy, Czechoslovakia and Germany.

Two high-frequency vacuum furnaces have been sold in Great Britain; they are of a type similar to that previously supplied to customers in the U.S.A. for the manufacture of special high-quality steel.

A considerable number of large complete mine hoists has been sold. Amongst these, mention can be made of six hoists for South Africa, of which the largest are for a net load of 11 tons, and have a hoisting speed of 15 m/s (50 ft/s) and a hoisting height of 1,300 m (4,300 ft). Also of interest are two mine hoists for the extension of the central shaft at Kiruna and hoists for customers in South Korea and the Philippines.

Large orders have been received for electrical equipment for paper and cellulose mills, including the electrical equipment for a newsprint machine for a wire width of 7,100 mm (23 ft) built in accordance with the sectional drive principle for a maximum speed of 900 m/min (3,000 ft/min), the highest so far in Sweden.

As far as the printing industry is concerned, orders have been received from companies in Sweden, Britain and France. In particular, mention can be made of electrical equipment for a Swedish newspaper which is installing presses which have an individual printing capacity of 70,000 copies per hour and are among the most rapid in the world. The motors for these presses are fed via transducer-controlled, semi-conductor rectifiers. The latter replace d.c. generators and are characterised by high efficiency, compactness and simplicity of installation.

Sales of deck machinery have increased. The first ship's winches of a new worm-gear type, and provided with a.c. multi-speed motors, have been sold to a Swedish shipping line. A new type of hydraulic steering gear has been put on to the market.

The sales of sugar centrifugals have been extended to the Argentine and Mauritius. Important orders have also been received from old customers in other parts of the world.

A considerable number of stand-by power plants and no-break sets has been ordered by the Swedish Board of Telecommunications and by Teléfonos de Mexico.

A new series of light electric hoists has been brought out which has considerably increased hoist sales.

Sales of lifts have increased still further and have included, amongst other things, high-speed lifts for the Wenner-Gren Center and the Hotell Continental in Stockholm.

The Traction Department has, in conjunction with Alstom Svenska Järnvägsverkstäderna, obtained an order from the Swedish State Railways for four motor-coaches for the Roslags Railway, and for the electrical equipment for six 4-coach, light-weight train sets. Nydqvist & Holm AB have ordered generators and traction motors for a further 25 diesel-electric locomotives which are to be supplied to the Swedish State Railways. Further, the Swedish State Railways have ordered 100 traction motors, each rated at 1,500 h. p., the largest traction motors which as far as is known, have ever been designed for a frequency of 16 $\frac{2}{3}$ c/s.

Deliveries to the Swedish State Railways include several more locomotives, of which three have a tractive effort of 80 tons and are among the most powerful locomotives in the world, six, three-coach, light-weight train sets



An Asea transformer, rated at 120 MVA, being unloaded in Sydney harbour, Australia. (54102)

and a trial delivery of two, three-coach, motor-coach train sets for Stockholm suburban traffic. Further, in collaboration with AB Svenska Järnvägsverkstäderna, 27 coaches have been supplied to the Stockholm Underground Railway.

The demand for standard products has increased considerably both in Sweden and abroad. The major part of the sales on the Swedish market is handled by *the Asea branch organisation*. In order to improve service to customers, branch offices are being added: in December, the Malmö branch opened a new office in Kristianstad, and, during the first half of 1961, the Gothenburg branch and the Jönköping branch are due to open offices in Skövde and Kalmar, respectively.

In order to extend the service facilities of the branches, specially trained service engineers are being stationed at all branches which have repair workshops attached to them, and these workshops are also being extended. In Malmö, a newly built workshop has been in use for rather more than a year, and in Norrköping, a new workshop is under construction. The planning and the other preparations for a new workshop in Luleå are practically finished and building work started this spring.

As a stage in the extension of service facilities, a special spare-parts bureau was set up at the Head Office in 1958, to which orders for spare parts can be sent from the branches by Telex. A thorough rationalisation of the handling of orders has made it possible to supply spare parts within 24 hours of receiving an order.

Sales of insulating material and glass-fibre products have markedly continued to rise.

The Nuclear-power Department. The manufacture of the equipment for the Ågesta reactor (R3/Adam) is pro-

ceeding, both in Asea's own workshops and those of the sub-contractors and the suppliers of components.

The main design and the cost calculations for the reactor at Marviken (R4/Eva) are to be completed by the middle of 1961 now that certain guiding principles on the design have been determined during the past year. The preparatory investigations are being carried out jointly by Asea and Nydqvist & Holm AB on the instructions of the Swedish State Power Board and AB Atomenergi.

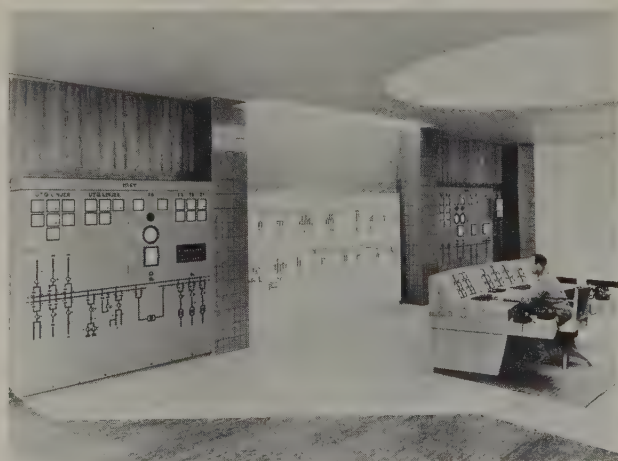
A detailed tender has been worked out by AB Reaktorteknik (Asea-Nohab) in collaboration with General Electric Co. for a boiling-water reactor with an electrical output of 50 MW and submitted to a Swedish consortium.

A research reactor, R2-0, has been supplied to AB Atomenergi at Studsvik. It was possible to keep within the very short delivery time of 12 months and the reactor became critical on 20th June, 1960.

The major part of an order from AB Atomenergi for 12 tons of sintered uranium dioxide slugs for reactor fuel elements has been completed. A plant for the manufacture of metal-clad fuel rods has been finished and a first delivery of aluminium-clad elements has started.

The running of the experimental installation for the manufacture of heavy water at Kvarntorp has now been concluded according to plan. The investigations have shown that home production of heavy water is technically and economically feasible.

Five power-stations in the Ätran River, with 12 generator sets in all, are remotely controlled from the Krokslätt control-room of Yngeredsfors Kraft AB. The remote-control equipment with the associated automatic equipment for the power-station was supplied by Asea. The installation makes use of carrier-frequency transmission on the power lines, and radio links. (56809)





Asea have supplied diesel-electric power plants for 13 radio-link stations in Colombia. To the left, an interior view of the station in Colombay. To the right, the exterior of the station and the radio-link aerial. (Z 12178, Z 12179)

At the beginning of 1961, work was started on a new Nuclear-power Laboratory at Västerås, primarily intended for experimental work in conjunction with the Marviken reactor (R4/Eva).

Installation-material Division. Sales rose steeply during 1960, and the turnover of the division was the largest hitherto.

Underground cables showed the greatest sales rise of any group. Metal-clad distribution boards, motor starters, light fittings and lamps also showed considerable increases in turnover.

Supplies of raw materials were good, even though delivery times were prolonged. Purchase prices rose during the latter part of the year.

New office and warehouse accommodation at Borlänge is now in use.

THE MAJOR AFFILIATED COMPANIES

Surahammars Bruks Aktiebolag

Ore was mined in the Company's own mines on a larger scale than in the previous year. The manufacture of pig iron and chills at Spännarhyttan has increased.

Production has increased at the steelworks at Surahammars. The manufacture of oriented electrical steels has now left the experimental stage and the standard of quality of the product has been successively increased throughout the year. In the case of the strip mill, a number of running-in problems were solved during the first part of the year. Quality has developed satisfactorily as far as the products of this mill are concerned. An installation for the vacuum casting of steel was taken into use at the end of the year.

The turnover amounted to 113.1 Mkr (97.2 Mkr in 1959). The average number of wage-earners employed



during the year amounted to 2,104 (1,990). The average number of other persons employed by the Company amounted to 359 (350).

AB Skandinaviska Elverk

The activities of the Company's departments and subsidiaries have developed satisfactorily during 1960. The distribution installations have been extended and reinforced. The programme of extension which is now going on aims, amongst other things, at creating reserve lines between various transformer areas, both locally and regionally.

During the year, still more SEV companies have been provided with radio-communication installations, thus increasing efficiency of operation and improving contact between the management and the working teams in the field in the case of service interruptions.

The extension of the distribution networks is proceeding with a view to the general adoption of certain standard voltages, in the first place 130 kV, 40 kV, 10 kV and 380-220 V. However, 70 kV, 50 kV and 30 kV will be retained in certain areas for a very long time yet. Retardation of distribution is now normally at a distribution voltage of 380/220 V and older networks with other distribution voltages are now being rebuilt. The work on this is expected to be finished within a few years.

Electrification has continued and the object is, if possible, to conclude it within the next few years. It is assumed in this connection, that normal economic co-operation from public bodies and the owners of the property in question will be forthcoming. A recent inventory has shown that, within the supply region of the SEV companies, the number of non-electrified properties which could be provided with electricity amounts to a little more than 400, or about 0.3 per cent of the total number of consumers catered for by the SEV companies.



An arc furnace of swing-roof type with rotatable bath. The diameter of the bath is 5 m (16 ft), the charge weighs 45 tons, and the furnace rating is 13 MVA. (55630)

During the year, the Company has handled the administration of Voxnans Kraft AB (65 per cent of the share capital of which is owned by Asea and 35 per cent by the Company), of the companies completely owned by the Voxnan company and of certain other companies in which Voxnan has interests, such as Blåsjöns Kraft AB (the Voxnan interest is 25 per cent), Brännälvens Kraft AB (57 per cent) and Trångfors AB (26 per cent). At the end of the year an electronic computer, SAAB-9001, was ordered for delivery at the beginning of 1962. It is to be installed in the new Head Office where it is to be included in the load-dispatching centre of Voxnans Kraft AB and will be used by the various departments and subsidiaries of the company for technical and economic calculations. Among its various uses, mention can be made of the planning of the development of hydro-electric and thermal power-stations, day-to-day production distribution, etc., and the adjustment of power charges, charging for current consumed, power sales analysis, etc.

The number of consumers amounted to 123,600 (120,600 the previous year). The turnover of energy rose during the year to 750.5 MkWh (708.5 MkWh), or by 5.9 per cent. The turnover of the Company, including resold power, amounted to 34.5 Mkr (32.5 Mkr) and the turnover of the Group to 68.7 Mkr (64.8 Mkr). The average number of employees in the entire SEV Group amounted to 844 (833) of which 701 (687) were engaged in the distribution side of the business and 143 (146) in the power-station business handled by SEV for Voxnans Kraft AB.

Aktiebolaget Elektroheliös

The activities of the Company during 1960 developed satisfactorily. The turnover amounted to 104.3 Mkr as



Asea has supplied complete electrical equipment for the roughing and plate mills and for the auxiliary machinery as well as comprehensive switchgear equipment for Oxelösunds Järnverks AB. The rolling mills are powered by rectifier-fed twin-drive d.c. motors, 2 x 200 ton-metres; the rectifier equipment is the largest ever installed in a Swedish rolling mill. The control equipment makes it possible for a very small number of men to run the rolling mill from the control-rooms. (56557)

against 92.6 Mkr the previous year, corresponding to an increase of 12.6 per cent. The average number of persons employed during the year amounted to 2,205 (1,722), of whom 690 (606) were salaried staff and 1,515 (1,116) were wage-earners.

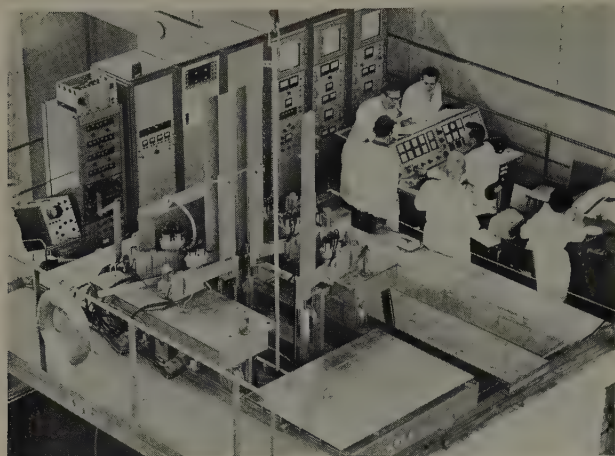
In order to meet increased demand for refrigerators and freezers, which are manufactured at Mariestad, the long-planned extension to the factory was started during the year and is expected to be completed at the end of 1961.

Sales of combined sink-and-cooker units developed according to plan. The demand for the Company's tabletop hot plates, cookers and small domestic equipment – irons, toasters, etc. – has increased. The combined refrigerator and chilled larder, which was introduced the previous year, is now selling well and the demand is good. The demand for the Company's industrial kitchen equipment and other industrial equipment continued to increase both in Sweden and on the export market.

The activities of the Company's four foreign subsidiaries developed according to plan. Exports increased considerably. The German and Norwegian companies started their activities in April while the Dutch and British companies were in operation during the entire year. The Company's fifth foreign subsidiary – the Danish one – started its activities on 1st January, 1961.

Voxnans Kraftaktiebolag

The activities of the Company developed satisfactorily during the year. The load continued to increase, thus



The first nuclear reactor manufactured entirely by Asea, the research reactor R2-0, has been supplied to the AB Atomenergi installation at Studsvik and was taken into use in accordance with a predetermined time-table. (55548)

making it possible to utilise previously built power and transmission installations to a greater extent than during previous years. Supplies of water were rather less than usual during the first half of the year, while supplies during the second half of the year were favourable. As a result of the abundance of hydro-electric power, power production in the Company's own thermal power stations was less than in 1959.

Norränge Kraft AB has, in collaboration with AB Arbrå Kraftverk, continued with the preparations for a 40 MW extension to the Norränge power-station in the Ljusnan River, of which the Norränge company's share amounts to 44 per cent. A decision on the proposed extension will be made during the spring of 1961.

The extension to the Linnvasselv power-station in the Linnvasselv-Brännälv River has continued. The installation, which will have a production capacity of about 70 MW and 200 MkWh/year, is expected to be taken into use during the autumn of 1962. The Company's share of production amounts to about 45 MW, 100 MkWh/year and the purchasing costs for the Swedish part are calculated to be less than 45 Mkr.

As in previous years, the Company has had at its disposal the transmission subscription on the super-grid available to AB Skandinaviska Elverk, and which amounted to 38,200 MWkm (36,100 MWkm).

The production of energy in the Company's own hydro-electric power-stations and the Company's share of production in Blåsjön power-station and Gulsele power-station amounted to 502,4 MkWh (374.1 MkWh). During the year, 33.6 MkWh (58.3 MkWh) has been station amounted to 502.4 MkWh (374.1 MkWh). During the year, 33.6 MkWh (58.3 MkWh) was

produced in the Company's thermal power-stations for the Company's own use.

The total turnover of energy of the Company amounted to 752.2 MkWh (687.5 MkWh) and income to 32.0 Mkr (32.0 Mkr).

Aktiebolaget Liljeholmens Kabelfabrik

As a result of brisk demand, turnover (including that of Bjurhagens Fabriker AB which is run on a commission basis) increased to 102.7 Mkr (83.9 Mkr the previous year).

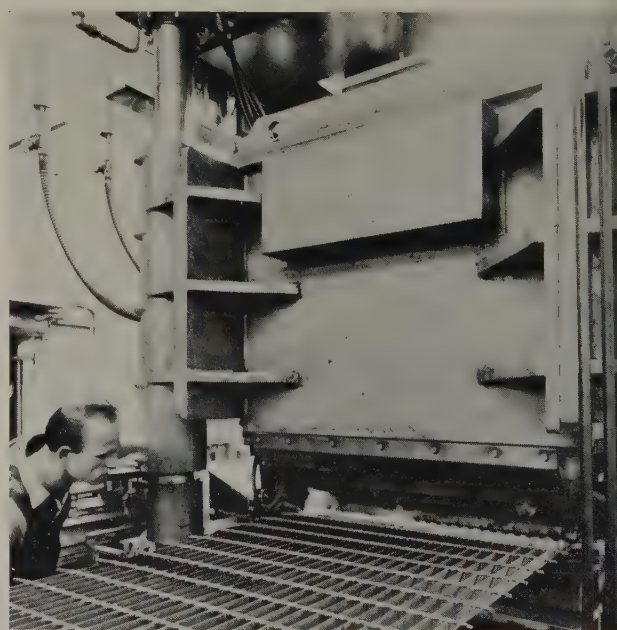
An increase in production was made possible by the rationalisation measures carried out in recent years, of which the most decisive was the transfer of all manufacture of semi-finished products to a factory bay outside the actual cable factory, thus making room for the redistribution of the machine tools, making a continuous flow of production possible.

The work of building a new factory bay with a floor area of 2,400 m² (26,000 sq. ft) has started.

The transition to plastic as an insulating material for cable sheathing continues, but the production of rubber-insulated and paper-insulated cable has also increased. The increase in orders is greatest in the case of high-voltage, paper-insulated cables.

Yet another world record in capacitor manufacture has been achieved in that a 400 kV series-capacitor rated at 185 MVA has been taken into use at Vittersjö. A

A hydraulically operated automatic projection welding machine, built by AB Asea Svetsmaskiner, for welding grid 1 m wide. The maximum welding current is 325 kA, the electrode pressure 35 tons. The production capacity is about one metre of grid per minute. (Z 12116)



During previous years, the greater part of the capacitor production has been exported.

The average number of salaried staff amounted to 287 (276) during the year, and the corresponding number of wage-earners was 829 (777).

AB Elektromekano

An agreement has been reached with Asea as to a re-grouping of the manufacturing programme with the object of enabling larger series to be produced in both companies and of making production more economic, and on the transfer of sections of the sales activities to Asea. In conjunction with this, the Elektromekano stores of finished products were sold to Asea at the end of 1960. The manufacturing of small motors by the Asea Group is to be concentrated at Hälsingborg and the installation of manufacturing equipment for this purpose is proceeding.

The turnover amounted to 46.3 Mkr (52.1 Mkr the previous year).

AB Elektrokoppar

The copper works have been well occupied. Deliveries from both the rolling mills and the wire-drawing mills as well as the enamelling works have increased considerably. Modernisation of the copper rolling mills continued. The activities of the aluminium works developed favourably during the year.

The turnover amounted to 86.6 Mkr (67.7 Mkr the previous year).

AB Elektroskandia

At the end of the year, the Company handed over its factory at Arboga to Asea and received in exchange increased capital resources for the expansion of its wholesaling activities.

During the year, the Company took over sections of the installation activities run by Elektromekano, including those in Stockholm.

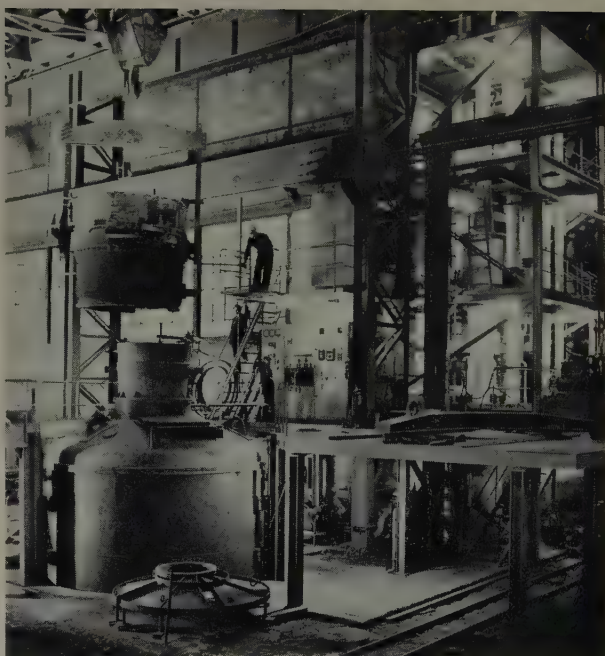
The new "Multi" system of metal-clad switching and distribution equipment was successfully introduced on to the market.

The turnover amounted to 120.4 Mkr (105.0 Mkr the previous year).

Hiss AB Asea-Graham (formerly Graham Brothers AB)

The turnover amounted to 26.8 Mkr (20.9 Mkr the previous year).

Among major orders, mention can be made of four high-speed lifts for the fifth skyscraper to be built in Stockholm, lift equipment and airfield lighting for Stage 2 in the building of the Arlanda airfield, transistor converters



Surahammars Bruks AB has installed plant for casting steel under vacuum. The vacuum process removes deleterious gases, mainly hydrogen, from the melt, providing a purer, stronger and better quality steel. In collaboration with Asea, a variant of this method has been developed, that is, ladle de-gassing with induction stirring of the melt. (56829)

for lighting purposes in passenger coaches on the Swedish State Railways, lighting-control equipment for the small stage of the Royal Dramatic Theatre in Stockholm, and equipment for airfield lighting in Mozambique.

By virtue of an agreement with Asea, the Company took over the lift manufacturing activities of Asea at the end of the year. In conjunction with this, the name of the Company was changed to Hiss AB Asea-Graham.

AB Asea Svetsmaskiner

During the year, sales of the Company's products increased considerably.

The orders received include, amongst other things, a butt seam-welding set, five sets of equipment for the manufacture of heavy chain, eleven automatic flash-welding machines for welding steam-boiler tubes, several projection welding machines for welding heat-exchangers, two large flash-welding machines for a maximum welding area of 16,000 mm² (25 sq. in.) and a similar one for a maximum welding area of 25,000 mm² (39 sq. in.), and two large pneumatically operated spot-welding machines and three seam-welding machines for joining wide strips for continuous annealing.

A new high-yield electrode of rutile type, Z18P, has been much in demand. Several types of electrode for use in the nuclear-power industry have been developed and put on to the market. Multi-operator rectifiers of ger-



A new production method for high-voltage cable has been developed at AB Liljeholmens Kabelfabrik. A very great length of cable is vacuum-dried in a container with a diameter of 5 m (16 ft) and a "roundabout" inside the device, operated from outside, feeds the cable into the continuous lead press without spoiling the vacuum. The method permits the production of cables with low losses and high dielectric strength. (Z 12117)

manium type rated at 2,000 A have been designed and delivered.

During the year, work started on the extension of the factories in Stockholm and Horda.

The turnover amounted to 23.9 Mkr (21.6 Mkr the previous year).

Affiliated companies outside Sweden

During 1960, sales by these companies showed a considerable increase both as far as products from Sweden, and products manufactured at the companies in question, were concerned.

The factory installations in Oslo, São Paulo and Melbourne are being extended. In Helsingfors, work has started on a new warehouse and factory building. In Paris, the factory has been regrouped in order to make possible the increased manufacture of commutator motors; certain types are to be manufactured to cover the requirements of the entire Group. Preparations have been made to set up new subsidiary companies in Mexico, Colombia, Uruguay, Argentine and Portugal and for a factory for the manufacture of motors in Mexico.

CERTAIN ASSOCIATED COMPANIES

AB Svenska Fläktfabriken

The share capital of the Company amounts to 30 Mkr, of which Asea owns 32.5 per cent; the remaining 67.5 per cent was sold in 1959 to Asea shareholders. The

dividend for activities during 1959 went to Asea in accordance with the conditions of sale and is included in the results of Asea's activities during 1960.

The Company has had a very successful year. The turnover of the entire Fläktfabriken Group amounted to 190 Mkr (155 Mkr. in 1959) and the turnover of the Parent Company to 134 Mkr (110).

Subject to the approval of the Annual General Meeting the Board has decided to increase the share capital to 40 Mkr by means of a new issue of shares amounting to 10 Mkr at 200 per cent. Asea has taken advantage of its right to subscribe.

Turbin AB de Laval Ljungström

The share capital amounts to 30 Mkr of which Asea owns 30 per cent, Förvaltnings AB Laval owns 30 per cent and the remaining 40 per cent was sold in 1959 to Asea shareholders. In accordance with the sale agreement, 70 per cent of the dividend for 1959 went to Asea, and this is included in the Asea results for 1960.

Features of the Company's activities during the year have been increased orders and keen competition. The turnover of the Turbin AB de Laval Ljungström Group amounted to 166 Mkr (172 Mkr in 1959) and the turnover of the Parent Company to 123 Mkr (170 Mkr in 1959 including the refrigeration and pump manufacturing businesses which were not included in the Parent Company in 1960).

AB Electro-Invest

The capital of the Company amounts to 18 Mkr of which Asea owns 50 per cent and AB Investor 50 per cent.

The activities of the company during the year have mainly comprised the supplying and the taking of orders for complete steam power-stations in Sweden and overseas.



This map shows places where the ASEA Group itself operates or is represented by agents. Because of limited space, only the headquarters of subsidiaries and representatives are shown. Through branch offices, and in other ways, ASEA is also represented in many other places. (Z 10692)

THE ASEA GROUP THROUGHOUT THE WORLD

ARGENTINA
Compañía SKF Argentina S.A.
Buenos Aires Calle Perú 545
Tel.: Casilla Correo 197
Telegr.: Roulement

AUSTRALIA
ASEA Electric (Aust.) Pty. Ltd.
Melbourne. ASEA House, 410-412, Lonsdale Street
Tel.: P.O. Box No. 786 F G.P.O.
Telegr.: Aseaward. Tel.: 67 6476.
Telex: 67 6476.
Ex: 67 6476.
Factory: Indwee St., Tottenham, Vic.
Tel.: 66 9241

BRAZIL
ASEA Elétrica S.A.
São Paulo, Rua Brigadeiro Tobias 356-7
Works: Guarulhos S.P. Via Monteiro Lobato 3285
Mail: Caixa Postal 7096, São Paulo
Telegr.: Aseabras

BRITISH EAST AFRICA
The Old East African Trading Co., Ltd.
Nairobi. Kenya. Philadelphia House.
Corner Travin Road. Victoria St.
Mail: P.O. Box 30013. Telegr.: Broche

CANADA
Canadian ASEA Electric Ltd.
Montreal, Que. City Centre Bldg.
1450 City Councillors St.
Mail: P.O. Box 670, Station "B", Montreal 2
Telegr.: Asea. Tel.: Victor 9-9361

CHILE
Aros Eléctrica S.A.
Santiago. Avenida Bulnes 157
Mail: Casilla 2118
Telegr.: Aseamotor

CHINA
Ekman & Co. AB
Gothenburg, Sweden. Stora Nygatan 29
Mail: P.O. Box 230, Gothenburg 1.
Tel.: 17 45 80. Telex: 2353

CHINA
The Ekman Foreign Agencies Ltd.
Shanghai. 185, Yuen Ming Yuen Road
Mail: P.O. Box 855. Telegr.: Ekmans

CHINA
The Ekman Foreign Agencies (China) Ltd.
Hongkong. 9, Ice House St.
Telegr.: Ekmans. Tel.: 31138

COLOMBIA
Compañía Sudamericana SKF
Bogotá. Avenida Caracas No. 15-08
Air mail: Apartado Aéreo 3733
Ord. mail: Apartado Nacional 1595
Telegr.: Roulement

CEYLON
Vulcan Trading Co. Private Ltd.
Colombo 1. 19, York Street
Telegr.: Vultra. Tel.: 3636

CUBA
Compañía SKF de Cuba, S.A.
Habana. Av. Menocal 58. Mail: Apartado 7133
Telegr.: Roulement

CYPRUS
Swedish Levant Trading Ltd.
Nicosia. Tricoupi St. 98
Telegr.: Skefko

GERMANY
ASEA Elétrica S.A.
São Paulo, Rua Brigadeiro Tobias 356-7
Works: Guarulhos S.P. Via Monteiro Lobato 3285
Mail: Caixa Postal 7096, São Paulo
Telegr.: Aseabras

INDONESIA
ASEA Elétrica S.A.
São Paulo, Rua Brigadeiro Tobias 356-7
Works: Guarulhos S.P. Via Monteiro Lobato 3285
Mail: Caixa Postal 7096, São Paulo
Telegr.: Aseabras

INDONESIA
ASEA Elétrica S.A.
São Paulo, Rua Brigadeiro Tobias 356-7
Works: Guarulhos S.P. Via Monteiro Lobato 3285
Mail: Caixa Postal 7096, São Paulo
Telegr.: Aseabras

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ASEA Elétrica S.A.
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Telegr.: Aseabras

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Mail: Caixa Postal 7096, São Paulo
Telegr.: Aseabras

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ASEA Elétrica S.A.
São Paulo, Rua Brigadeiro Tobias 356-7
Works: Guarulhos S.P. Via Monteiro Lobato 3285
Mail: Caixa Postal 7096, São Paulo
Telegr.: Aseabras

DENMARK
Elektricitets Aktieselskabet ASEA
Copenhagen K. Bredgade 45
Telegr.: Asea. Tel.: MI 4666.
Telex: 55/5820

ECUADOR
Ivan Bohman & Co.
Guayaquil, Fco de P. Icaza 422-426
Mail: Casilla 1317. Telegr.: Boman

EGYPT U.A.R.
The Delta Engineering Co. SAE
Cairo. 18, Emad-el-Dine Street
Mail: P.O. Box 439
Telegr.: Erefpeco

FINLAND
OY ASEA AB
Helsingfors. Alexandersg. 21
Telegr.: Asea. Tel.: Trunk call A 765,
local call 12501
Telex: 57/12709

FRANCE
ASEA-HILLAIRET
S.A. de Constructions Electro-Mécaniques
Paris (8^e). 2, Rue Paul Cézanne
Mail: B.P. 739-08
Telegr.: ASEA, Paris. Tel.: Balzac 31-60

EASTERN GERMANY
Nils Wennardt AB
Gothenburg, Sweden, Kungsgatan 15
Mail: P.O. Box 2031
Telegr.: Niwab

WESTERN GERMANY
ASEA Elektrizitäts G.m.b.H.
Frankfurt/Main. Holzhausenstrasse 14
Telegr.: Aseaf Frank. Tel.: 59 12 27

GREAT BRITAIN
Fuller Electric Ltd.
London E. 17, Fulbourne Road
Telegr.: Autosyncro, London
Tel.: Larkwood 2350. Telex: 2-2342

HOLLAND
Groeneveld, van der Poll & Co's
Electrotechn. Fabriek N.V.
Amsterdam. Head off.: de Ruyterkade 41/43
Telegr.: Groenpol. Tel.: 64474. Telex: 11177
Sales office for ASEA products:
Technisch Verkoopkantoor Groenpol
Amsterdam C. Prinsengracht 13-15
Mail: P.O. Box 1188

ICELAND
Johan Rönning H/F
Reykjavik.
Mail: P.O. Box 883
Telegr.: Rönning. Tel.: 4320

INDIA
ASEA Electric India, Private Ltd.
Bombay. Yaffi Bldg. Goa Street, Fort
Mail: P.O. Box 941
Telegr.: Aseaf India. Tel.: 26 41 81

ASEA Electric India, Private Ltd.
Calcutta. 4, Lyons Range
Mail: P.O. Box 194
Telegr.: Aseaf India. Tel.: 22 41 14

ASEA Electric India, Private Ltd.
Madras 1. Mercantile Bank Building
16, First Line Beach.
Mail: P.O. Box 123
Telegr.: Aseaf India. Tel.: 55544

IRAN
Poust Pashm Panbeh Trading Co.
Teheran. Avenue Ekbatan 213-215
Telegr.: Ekbapashm
Tel.: 362 95

IRAQ
H. Baladi & Fils (Iraq) W.L.L.
Baghdad. 5/10/1 Saadun Street-Battaween
Telegr.: Baladfis. Tel.: 87510

IRELAND
ASEA Electric (Ireland) Ltd.
Dublin. 4 Mount Street Crescent
Telegr.: Asea. Tel.: 67033

ISRAEL
Jos. Muller, A & M Engineer Ltd.
Haifa. 37, Haatzmauth Rd.
Mail: P.O. Box 243
Telegr.: Mullerson

Jos. Muller, A & M Engineer Ltd.
Tel Aviv. 8, Mikveh Israel
Mail: P.O. Box 2099. Telegr.: Mullerson

ITALY
Soc. Italiana di Eletticità ASEA
Milan. Via Generale G. Fara No. 39
Telegr.: Aseamil. Tel.: 65 33 41

JAPAN
Gadelius & Co. AB
Stockholm. Eriksbergsgatan 1 A
Telegr.: Knutsius. Tel.: 23 28 00

Gadelius & Co. Ltd.
Tokyo C. 3-19, Denma-cho, Akasaka,
Minato-ku. Mail: P.O. Box 1284.
Telegr.: Goticus

Gadelius & Co. Ltd.
Kobe. 67/2 Kyo-machi, Ikuta-ku.
Mail: P.O. Box 802
Telegr.: Goticus

LEBANON
H. Baladi & Fils
Beirut.
Mail: P.O. Box 432
Telegr.: Baladfis

MALAYA
James Warren & Co. Ltd.
Kuala Lumpur. 3 Clarke St.
Mail: P.O. Box 288. Telegr.: Planstor

MAURITIUS
Mauritius Trading Company Ltd.
Port-Louis.
Mail: P.O. Box 201
Telegr.: Agentou, Port-Louis

MEXICO
Compañía SKF Golfo y Caribe, S.A.
Mexico 3, D.F.
Buenavista No. 3
Mail: Apartado 98, Mexico 1, D.F.
Telegr.: Roulement

NEW ZEALAND
ASEA Electric (N. Z.) Ltd.
Wellington. Huddart Parker Bldg.
Telegr.: Asea

ASEA Electric (N.Z.) Ltd.
Auckland. Cnr. Railway Avenue & Leek Street,
Newmarket.
Mail: P.O. Box 3239, Telegr.: Asea

NORWAY
A/S Per Kure, Norsk Motor- og Dynamofabrik
Oslo. Universitetsgaten 24
Works: Hasle, Oslo
Telegr.: Kuremotor. Tel.: 41 58 10 Telex 1105

PAKISTAN
Danpak Limited
Karachi. Adamjee Chambers McLeod Road
Mail: P.O. Box 5109
Telegr.: Danpaka. Tel.: 34257-32334

PERU
Compañía ASEA del Perú S.A.
Lima. Avenida Wilson 958
Mail: Apartado 2982
Telegr.: Aseamotor

PHILIPPINES
Scandia Incorporated
Manila. Ledesma Bldg. Sta. Lucia St., Intramuros
Mail: P.O. Box 357
Telegr.: Scandia. Tel.: 3-49-41

POLAND
ASEA
Warsaw. Nowy Swiat 19
Telegr.: Asea. Tel.: 692-35, 692-31

PORTUGAL
Asea Electrica Limitada,
Lisbon 1, Rua de Artilharia
Um No. 104
Telegr.: Aseaport

PUERTO RICO
Badrena & Pérez, Inc. San Juan.
Mail: P.O. Box 596

SOUTH AFRICA
Reunert & Lenz Ltd.
Johannesburg. Reunert House. 10 Anderson St.
Mail: P.O. Box 92. Telegr.: Rockdrill
Tel.: 33-5201, 33-0561

ASEA Electric South Africa (Pty.) Ltd
Pretoria. 1, Buitekant Street
Mail: P.O. Box 691
Telegr.: Lectroasea

SPAIN
Soc. Española de Electricidad ASEA
Madrid. Av. José Antonio 70
Mail: Apartado 483
Telegr.: Asea. Tel.: 47 61 02

Soc. Española de Electricidad ASEA
Barcelona 10. Av. José Antonio 674
Mail: Apartado 1213
Telegr.: Asea. Tel.: 31 22 09

Soc. Española de Electricidad ASEA
Bilbao. Calle Henao 2
Telegr.: Asea. Tel.: 13099

SYRIA U.A.R.
Technical Supplies & Trading Co., S.A.
Damascus. Mail: P.O. Box 527
Telegr.: Tesutco

Technical Supplies & Trading Co., S.A.
Aleppo. 240, Al Walid Street
Mail: P.O. Box 527

THAILAND
The East Asiatic Company, Ltd.
Copenhagen, Denmark. 2, Holbergsgade
Planning & Projects Dept. Telegr.: Plandep
Machinery Dept. Telegr.: Mandarin

The East Asiatic Co. Ltd.
Bangkok, 53-55 Oriental Avenue.
Telegr.: Pyramide

Thai-Dan Corporation, Ltd.
Bangkok, 55 Oriental Avenue. Telegr.: Thaidan

Oriental Machinery Stores
Bangkok, Worachak Road. Telegr.: Machineco

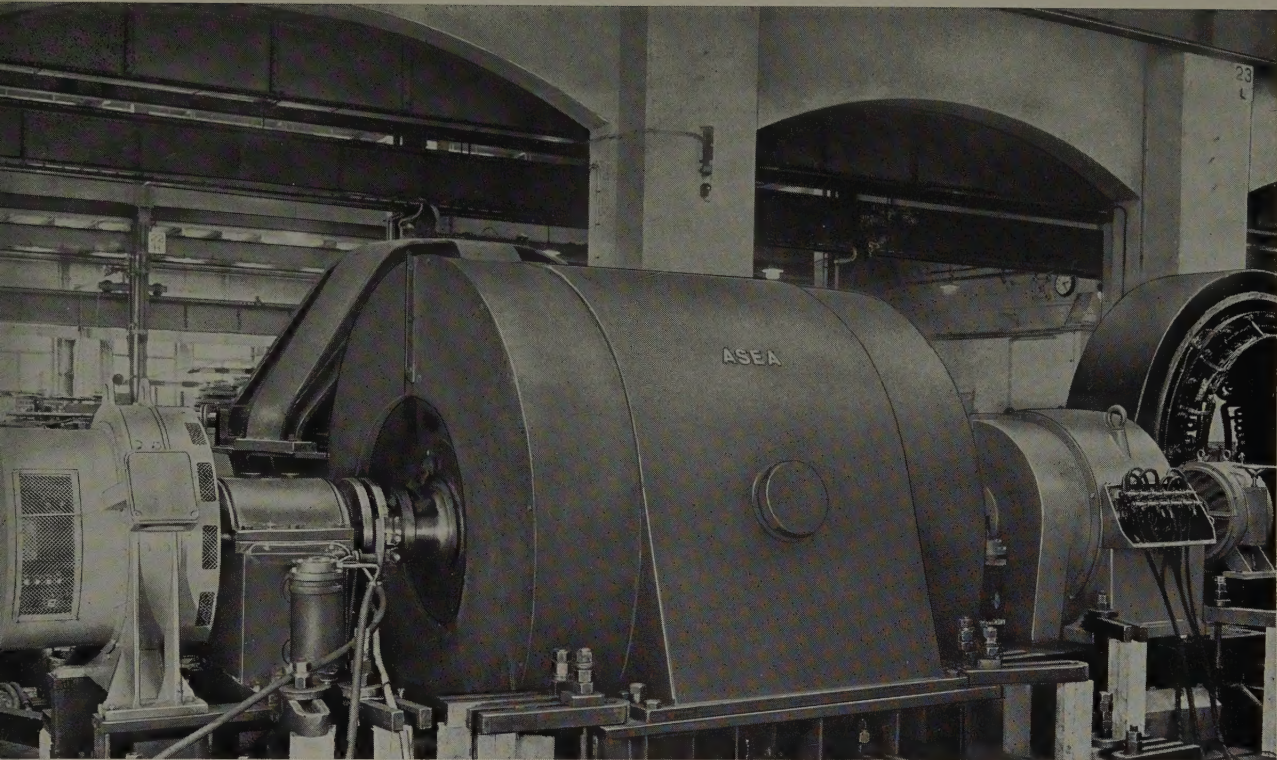
TURKEY
SKF Bileli Rulmanlari Limitet Sirketi
Mail: P.O. Box 51. Sisli
Telegr.: Eskae. Tel.: 47 42 38

URUGUAY
Compañía Sudamericana SKF
Montevideo. Calle Cerro Largo 1089
Mail: Casilla 134. Telegr.: Roulement

U.S.A.
ASEA Electric, Inc.
New York 36, N.Y. 500 Fifth Avenue
Telegr.: Aroseli. Tel.: Lackawanna 4-7970

ASEA Electric, Inc.
San Francisco 5. Tidewater Bldg.
55 New Montgomery Street.
Tel.: Exbrook 2-5276

VENEZUELA
Agencias Industriales Cía Anónima [AICA]
Caracas. Palma A Miracielos No. 51
Mail: Apartado 2022. Telegr.: Aica



(54876)

NEWS IN BRIEF

SHORT-CIRCUIT GENERATOR FOR CHICAGO

Asea have supplied the S. & C. Electric Co., Chicago, with a short-circuit set consisting of a three-phase synchronous short-circuit generator type G 1513 with driving motor and exciter, for use in its high-power laboratory.

The three-phase short-circuit power of

the generator amounts to 60,000 kVA at 1,000 r/m, 60 c/s, and full power can be provided at four different voltages, that is, 15,000, 8,950, 7,750 and 4,475 V. The single-phase short-circuit power is 47,000 kVA.

The set is small, robust and reliable in service and is particularly suitable for, amongst other things, the testing of high-power fuses.

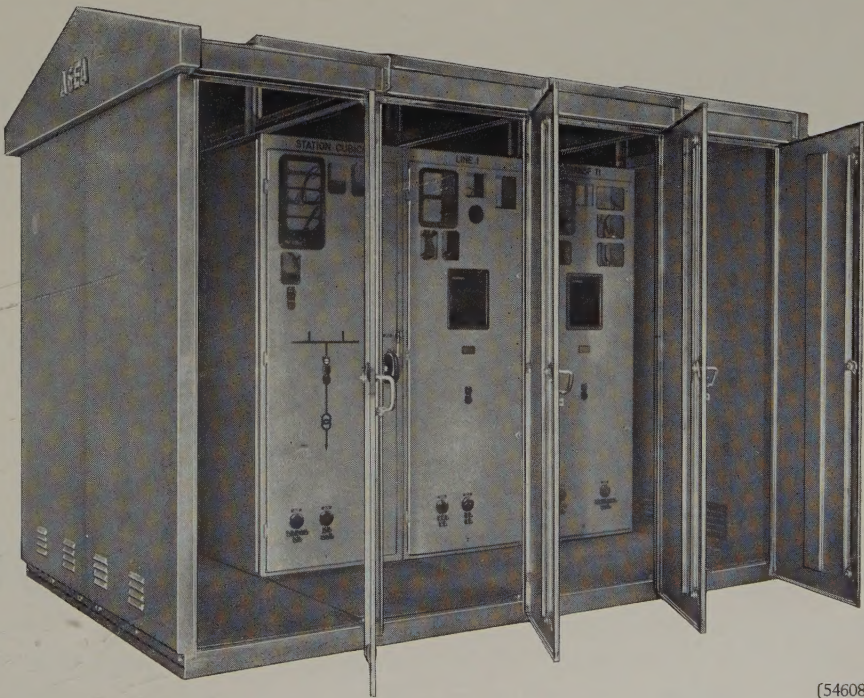
The control equipment, which was also supplied by Asea, includes, amongst other things, a sequence controller for the accurate steering of single-phase or three-phase short-circuit frequencies. Special, single-phase, high-speed making switches make it possible to determine in advance the moment of short-circuiting with an accuracy of ± 5 electrical degrees.

Asea Reg. 4422

KIOSK FOR THE OUTDOOR ERECTION OF 10 kV SWITCHGEAR OF TYPE VHB

A feature of the design is that the kiosk is built up of standard elements which are available in sizes suited to the cubicle dimensions of the switchgear and which comprise elements for the roof, walls, floor and frame, as well as end pieces consisting of two elements. The switchgear cubicles help to support the construction.

Asea Reg. 5860



(54608)



(56171

GAS-TURBINE POWER-STATION IN VENEZUELA

The first gas-turbine power installation supplied to a customer outside Sweden by Turbin AB de Laval Ljungström and Asea is now being completed. The power-station is situated in Puerto La Cruz, an oil-exporting port about 300 km (190 miles) east of Caracas, the capital of Venezuela.

The station consists of three sets, each rated at 7.5 MW, 13.8 kV, 60 c/s, directly connected to transformers with the ratio 13.8/115 kV.

The fuel used is natural gas which is brought by pipe-lines from the oil-fields around the town of Anaco about 80 km

(50 miles) inland. Diesel oil is used as emergency fuel and, if necessary, it is possible to drive the set with a mixture of gas and diesel oil.

The main contractors for the installation, which is owned by the Government Agency CADAPE, are the Asea agents in Caracas, AICA (Agencias Industriales Compañía Anónima). Turbin AB de Laval Ljungström supplied the turbines and accessories. Asea supplied all the electrical equipment including the electro-hydraulic turbine governors, the control equipment, the transformers and the 115 kV outdoor switchgear.

The running of the station is very largely automatic.

msl Asea-Reg. 7213

The Asea Journal is published monthly review.

All correspondence should be addressed to the Editor, Publicity Department, Asea, Västerås, Sweden.

Articles or extracts from this Journal may be reprinted on condition the name - Asea Journal - is clearly stated.

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